ENGINEERING

NOV 9 1961
ENGINEERING
LIBRARY

sign:
gonomic Thinking
Crane Cab Design

nstruction:
rain Links
Strain Gauging Outdoors

tomobile Review:
rdon Wilkins Reviews
gine Development

tals and Materials:
gh Pressure Nylon Hose
Hydraulics

oduction:
avyweight and
gh Precision Engineering

duct Profile:
yland Comet Goods Truck

search Report:
w Approach to
rmal Fatigue Testing

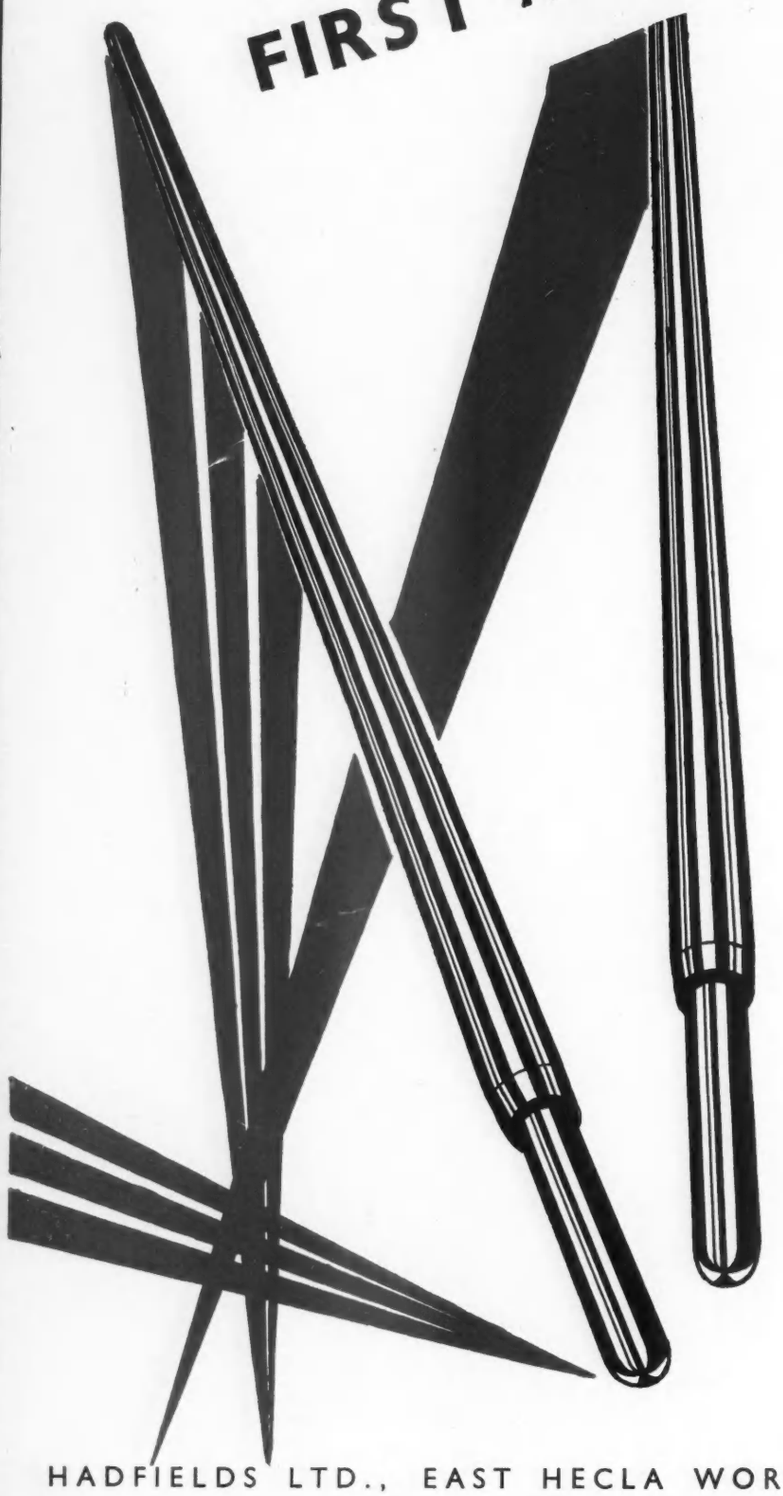
E
2/-

eller Balancing

HADFIELDS...

FIRST AND FOREMOST...

.. in the production of high quality alloy steels.



1878 MANGANESE STEEL

1948 BORON STEELS

Hadfields Boron Steels for neutron absorption in Control and Shielding systems.
Complete Control Rods and Sandwich Plate incorporating these steels.

ERA BORON 1 STEEL
" " 2 "
" " 3 "
" " 4 "
" " 5 "

} Hadfields range of Boron Steels 1% to 5%

ERA C.R. BORON STEELS — 18/8 type with Boron content up to 4%.

ERA HLC — 18/8 Stabilised with Co ·01% max. or Co ·01% max. and Mn ·10% max.

GALAHAD LC — 13% Cr. with Co ·01% max.

HECLA 35 LC — Low Carbon Steel with Co ·01% max.

HECLA 35 LM — Low Carbon Steel with Mn ·10% max.

HECLA 35 LCM — Low Carbon Steel with Co ·01% max. and Mn ·10% max.

HADFIELDS
SHEFFIELD

HADFIELDS LTD., EAST HECLA WORKS, SHEFFIELD, ENGLAND.

20 October 1961

Vol. 192 No. 4983

Founded in 1866

ENGINEERING

PUBLISHED EVERY FRIDAY

36 Bedford Street London WC2 England Telephone : Temple Bar 3663

Contents

494 Design

Ergonomic Thinking in Crane Cab Design
By R. G. Sell, A. W. Box and K. Leyshon

Developing Internal Manufacturing Standards, Goliath Crane with Triangular Cross Beam, Distillation Plant Supplied in Sections, Hydraulic Tension Controller, Stress Relieving Furnaces Use no Firebricks, Flat Belting for Hovercraft Drive

499 Construction

Strain Links for Outdoor Strain Gauging
By K. E. Easterling

Construction Progress at Dungeness

506 New Plant and Equipment

Outboard Motors, Portable Conveyor, In-line Process Pump, Punching Press, Steam Turbines, Adjustable Venturis

Machine Vice, Tube-End Flaring Machine, Coal Discharger, Spraying and Stoving Machine, Compound Flow Fan, Guillotine Shearing Machine.

Gas Analyser, Pneumatic Screwdriver, Shaft Seal, Scrap-Processing Machinery, Sequence Timer, Head Harness

510 Metals and Materials

High-Pressure Nylon Hose in Hydraulics

Modified Stainless Steel, King Pin Shrunk with Liquid Nitrogen, Chromate Coatings for Brass and Zinc, Rubber Bags Used as Gasholders, Production Heats of Uranium-Steels, Spiral Conduit with Sealing Ring

512 Production

Heavyweight High Precision Engineering

521 Research

Research Report:
New Approach to Thermal Fatigue Testing
By Dr. P. G. Forrest and A. B. Penfold

Electronic Thawing for Frozen Fish, Ceramics Found Suitable for MHD Power, Circuit Breaker for Extra-High Voltages

493 Impact

501 Human Element

509 Companies

517 Marketing

502 Automobile Review

Engine Changes Both Here and Abroad
By Gordon Wilkins

Rootes Introduce the Hillman Super Minx, The New 4-Litre Lagonda Rapide, Daimler Limousine has Longer Wheelbase

Sealed-Charge Batteries and Battery Chargers, An Anti-Theft Master Switch, Fuel Injection Systems, An Improved Range of Car Radios, Diesel Engine Starter for Low Temperatures, Reversed Sleeve Propeller Shaft

518 Product Profile

The Leyland Comet Goods Truck

524 At Home

Wash and Freeze

497 Plain Words

By Capricorn

497 Letters to the Editor

When is a Gramophone?
Anthony E. Brooks

Night Use of Electricity
A. M. Gunner

497 Events in Advance

514 Publications

On the Shelf
By Frank H. Smith

Books Reviewed :

The Science of Wealth

Channel Underground

Porsche: The Man and His Cars

Introductory Soil Mechanics and Foundations From Theory to Practice in Soil Mechanics

Trade Publications and New Books

Cover Picture

The cover picture shows a double-inlet aerofoil-bladed impeller for a forced draught fan being dynamically balanced. (*Nurnberg photograph for* ENGINEERING)

Subscription Rates: Editorial page 524 **Index to Advertisers: Overleaf** **Appointments Advertisements: Face Editorial page 508**

Advertisers in 'Engineering' this week

	PAGE
Aabacas Eng'g. Co., Ltd.	13
Adamson, J., & Co., Ltd.	10
Airscrew Co. & Jicwood, Ltd.	42
Allen, A. H., & Co. (Engineers) Ltd.	38
Allen, W. H., Sons & Co., Ltd.	29
Amal, Ltd.	66
Armstrong Stevens & Son, Ltd.	24
Arrol, Sir Wm., & Co., Ltd. *Wrapper*	VI
Associated Electrical Industries, Ltd. Heavy Plant Division.	28
Transformer Division.	32
B.T.R. Industries, Ltd.	8
Barry, Henry & Cook, Ltd.	13
Begg, Cousland & Co., Ltd.	68
Beresford, Jas., & Son, Ltd.	40
Berry, H, & Co., Ltd.	41
Booth, Joseph, & Bros.	38
British Electrical Development Association	5
British Hoist & Crane Co., Ltd.	6
British Steam Specialties, Ltd.	13
Brookhirst Igranic, Ltd.	43
Broom & Wade, Ltd.	18 & 19
Brown, David, Corpn. (Sales) Ltd.	15
Burndept, Ltd.	63
Carter Thermal Eng'g., Ltd.	54
Central Electricity Generating Board.	11
Clyde Crane & Booth, Ltd.	38
Clyde Crane & Eng'g. Co.	38
Cohen, G., Sons & Co., Ltd. *Wrapper*	VIII
Colt Ventilation, Ltd.	25
Conveyor & Elevator Co. (1936) Ltd.	10
Crofts (Engineers) Ltd.	21
Dallow Lambert, Ltd.	39
Darlington Forge Ltd.	47
Donkin, Bryan, Co., Ltd.	16
Drum Eng'g. Co., Ltd.	70
Eagle Pencil Company	63
Edwards, F. J., Ltd.	46
Eltron (London) Ltd.	13
"Engineering" Calendar.	46
English Electric Co., Ltd. Metal Industries Division.	7
Epsylon Industries, Ltd.	30
Eutectic Welding Alloys Co., Ltd.	37
Fairfield Shipbuilding & Eng'g. Co., Ltd.	34
Ferranti, Ltd.	61
Firth, Thos., & John Brown, Ltd. *Wrapper*	IV
Fullerton, Hodgart & Barclay, Ltd.	48
Godfrey, Sir G., & Partners (Ind.) Ltd.	14
Goulder, J., & Sons, Ltd.	2
Grafton Cranes, Ltd.	54
Hadfields, Ltd. *Wrapper*	II
Hall, J. & E., Ltd.	51
Hartleys (Stoke-on-Trent) Ltd.	54
Heap, J., & Co., Ltd.	70
Herbert, A., Ltd.	36
Hilmor, Ltd.	12
Hockley Foundry Co., Ltd.	40
Hoffmann Manufacturing Co., Ltd.	24
Hunt Heat Exchangers, Ltd.	13
Imperial Chemical Industries, Ltd. General Chemicals Division.	20
Jones & Lloyd, Ltd.	13
Joy-Sullivan, Ltd.	72
Keith Blackman, Ltd.	31
Laidlaw, Drew & Co., Ltd.	6
Lockheed Precision Products, Ltd.	60
Low, A., & Sons, Ltd.	9
Lucas Industrial Equipment, Ltd.	22
Lysaght-DeVilbiss Division J. Lysaght's Ltd.	23
McGraw-Hill Publishing Co., Ltd.	4
McNeil, C., Ltd.	12
Marconi Instruments Ltd.	50
Markland Scowcroft, Ltd.	17
Marston Excelsior, Ltd.	69
Mavor & Coulson, Ltd.	71
Mercer, T., Ltd.	40
Metalastik, Ltd.	62
Micanite & Insulators Co., Ltd.	66
Mirrlees, Bickerton & Day, Ltd. *Wrapper*	V
Morganite Carbon, Ltd.	49
Morris, Herbert Ltd.	69
National Coal Board.	35
National Industrial Fuel Efficiency Service.	55
Neal, R. H., & Co., Ltd.	59
Newbury Diesel Co., Ltd.	24
Parks Forge, Ltd.	24
Parsons, C. A., & Co. Ltd.	64
Peglers, Ltd.	55
Pitman, Sir Isaac, & Sons, Ltd.	4
Portasilo, Ltd.	8
Powder Couplings, Ltd.	36
Priest Furnaces, Ltd.	40
Ratcliffe, F. S. (Rochdale) Ltd.	30
Robertson, W. H. A., & Co., Ltd.	67
Robson, G., & Co. (Conveyors) Ltd.	30
Rocol, Ltd.	33
Rubert & Co. Ltd.	46
Russell Constructions, Ltd.	4
Scriven Machine Tools, Ltd.	10
Simon-Carves Ltd.	52
Slick Brands, Ltd.	38
South Durham Steel & Iron Co., Ltd. *Wrapper*	VII
Stillite Products, Ltd.	40
Taylor Industrial Clutches.	30
Teddington Autocontrols, Ltd.	56
Thermal Syndicate, Ltd.	8
Timber Development Association, Ltd.	65
Tonks, J., & Co., Ltd.	10
Unbrako Socket Screw Co., Ltd.	46
Unicone Co., Ltd.	12
Vandervell Products, Ltd.	26 & 27
Vulcan Boiler & General Insurance Co., Ltd.	70
Ward, Thos. W., Ltd.	58
Weir, G. & J., Ltd. *Wrapper*	III
Wellman Bibby Co., Ltd.	48
Wellman Smith Owen Eng'g. Corpn., Ltd.	68
Welsh Metal Industries, Ltd.	53
Whittaker Hall & Co. (1929) Ltd.	56
Wiggin, H., & Co., Ltd.	44 & 45
Wilmot Breeden, Ltd.	57
Worcester Valve Co., Ltd.	61
Wright, Bindley & Gell, Ltd.	60

'Engineering' Appointments Section inside Editorial Section

Allen, W. H., Sons & Co., Ltd.	2
G.K.N. (New Zealand) Ltd.	1
Management Selection, Ltd.	
Steel, Peech & Tozer	

Classified: Trade & Technical

Amis, I. R., Ltd.	3
Cardale, Keith, Groves & Co.	3
Chamberlain & Willows	3
Drysdale & Co., Ltd.	4
Edwards, F. J., Ltd.	3
Government Surplus Stores	3
Hillier Parker, May & Rowden	3
Marks & Clerk	
Manchester College of Science & Technology	
Norris Bros., Ltd.	
Plint & Partners	
Research Engineers, Ltd.	
Search, Wm. G., Ltd.	
Simm, G. E. (Machinery) Ltd.	

Sales and Valuations

Butcher, Henry, & Co.	2
Fuller, Horsey Sons & Cassell	2
Farmer, Leopold, & Sons	
Goddard & Smith	
Knight, Frank & Rutley	

For 'Engineering' Appointments Section turn to the centre of Editorial Section

Goulder manufacture 17 types of gear measuring instruments

write for particulars to:

J. Goulder & Sons Ltd., KIRKHEATON, HUDDERSFIELD. Tel: *Huddersfield 5252*

JG16

SALES AND VALUATIONS

Knight Frank & Rutley

Industrial Surveyors

20 Hanover Square
London W.1

MAYfair 3771. (20 lines)

G5

SALES AND VALUATIONS

LEOPOLD FARMER & SONS

conduc

AUCTION SALES

and

VALUATIONS

OF PLANT, MACHINERY AND INDUSTRIAL PROPERTIES

46 GRESHAM STREET, LONDON, E.C.2.

Telephone: MONarch 3422 (10 lines)

Telegrams: Sites, London

G 6

TRADE AND TECHNICAL

SALES AND VALUATIONS

HENRY BUTCHER and Co.

Auctioneers, Valuers and Surveyors

Specialising in the

SALE & VALUATION of

Engineering & Allied Works Plant & Machinery

FACTORY AGENTS

73 CHANCERY LANE, LONDON, W.C.2.

HOLBORN 8411 (8 LINES)

G 4

EXPERIMENTAL

DEVELOPMENT WORK

PROTOTYPES

SPECIAL PURPOSE MACHINES

PRECISION ENGINEERING FROM SMALL SCIENTIFIC INSTRUMENTS TO MACHINES AND APPARATUS OF SEVERAL TONS

A.I.D. AND A.R.B. APPROVED

RESEARCH ENGINEERS LIMITED

ORSMAN ROAD, SHOREDITCH, N.1.

SHO 7811/7815

G 900

GODDARD & SMITH

For the Sale & Valuation of all types of Industrial Premises Plant & Machinery

GODDARD & SMITH

22 King Street

St. James's, S.W.1.

Tel: WHI 2721

(20 lines)

G 1

FULLER HORSEY

SONS & CASSELL

Industrial Valuers
Surveyors
Auctioneers
and
Estate Agents
since 1807

10 LLOYD'S AVENUE, LONDON, E.C.3

ROYAL 4861

G 8

CONSULTANTS AND EXPERIMENTAL WORK

NORRIS BROS. LTD.

53 VICTORIA ST., LONDON, S.W.1

Tel: ABBey 6132

and at Burgess Hill, Sussex

Specialists in

RESEARCH, DESIGN AND DEVELOPMENT

throughout the whole Engineering Industry

G 900

PLINT & PARTNERS LTD.

Blakes Road, Wargrave, Berks.

Tel: Wargrave 427

MECHANICAL ENGINEERS

investigate research problems and design and manufacture equipment for

RESEARCH & DEVELOPMENT INSTRUCTION

G 776

ENGINEERING Impact

of Not Enough Electricity

If there are any optimists still left who think that nuclear power plants will spring up rapidly in all industrialized countries, to solve national power problems with the aid of a magic uranium wand, they were dealt another blow at Baden-Baden last week, when speaker after speaker at the 12th international congress of UNIPEDE (International Union of Producers and Distributors of Electrical Energy) poured cold water not to moderate the hypothetical reactors themselves, but instead to moderate nuclear progress.

This slowing down in nuclear power programmes, outside Britain, is not new. What was new was a somewhat similar waning of enthusiasm for new water-power development. In most European countries there is little "normal" hydro-power left to harness.

This situation led engineers from most European countries to turn their thoughts towards first, harnessing minor streams, and secondly, to start new methods of evaluating the advantage to be gained from increasing existing reservoir heights and capacities. Capital cost per kilowatt of new thermal plants continues to fall, whereas the capital cost of hydro-plants tends, on the whole, to rise.

Moreover, with electricity demand continuing to rise by at least 7 per cent per annum, the proportion of the total load that water power can furnish becomes rapidly smaller, so that the incentive even to use its great advantage, the inherent storage capability, becomes less. But many speakers were quick to point out that existing installations would continue to provide useful amounts of power long after the amortization period had been reached, and when thermal plants built at the same times had long since been relegated to emergency running or to the scrap heap.

There is no easy solution to the very severe problems associated with doubling power generating capacity every ten years. In all the years up to the last decade, there was plenty of coal in most coal-bearing areas, plenty of water power in the hydro-plant areas, and lately the promise of cheap nuclear power always round the corner. Whatever decision was reached, one could scarcely go wrong. With nuclear plant still costly, water power tending to run out, and coal and oil supplies having at least finite limits, the possibilities of error are, to say the least, considerable.

Calder Hall's Contribution

Five years have passed since the opening of the world's first large scale nuclear generating station at Calder Hall by Her Majesty the Queen on 17 October 1956. During this time the station has had a clean record and exceeded the original design criteria in some cases by a factor of 25 per cent. The station has given the nation a positive lead as a nuclear producer and raised the prestige of the whole industry.

There have been no radiation releases and the high standard of fuel element manufacture has reduced the number of element failures to five, which mostly occurred during the first year. Each failure was rapidly detected by the burst-cartridge detection equipment picking out the increase of radioactive fission products escaping into the coolant gas stream. The introduction of further tests has eliminated any failure during the past year.

One limitation with the Calder Hall station, which the later Central Electricity Generating Board stations have eliminated, is the need to shut the reactor down to load and unload the fuel elements. This is necessary about once a year and initially the operation took eleven weeks, but has now been reduced to four.

In spite of this, the average load factor for the station during the past year was 88 per cent, which compares favourably with that for the latest coal-fired stations. It has also been possible to increase the power level by 25 per cent above the original design figure.

The station is basically a plutonium producer, but it is also capable of supplying 200 MW of electricity, and it has been extensively used by the CEGB to conduct in-pile experiments and investigations for their present range of nuclear power stations, with particular reference to fuel elements.

Not Enough Driving Space

Motor-vehicle mileage in Britain went up by 7 per cent last year. Temporary relief measures are producing some improvement: according to Ministry of Transport figures, traffic in Central London is actually moving faster for the first time for many years. The improvement in speed is about 9 per cent, in spite of an increase of 4 per cent in traffic—also the highest for some time. Average speed today is about 10·7 mph.

The success is attributed (according to the Ministry's report "Roads in England and Wales") very largely to the installation of parking meters, with the rider that waiting restrictions must be judiciously applied to adjacent streets as well. In London the "clearway" from Knightsbridge to the Chiswick Flyover (on the A4 route to the West) no doubt has played its part in easing the flow. It is to be extended to London Airport later this year. Another one on the A40 (the route to Oxford and South Wales) is proposed, running from Marble Arch in Central London to Acton.

Thus an integrated plan is slowly appearing, though the effect of restricting traffic on one road is often to divert it to another, and the whole job has to be done again.

Long distance transport likewise depends on free movement if road is to compete with air and rail. Eleven further motorway schemes on five major projects are before the Ministry. One includes a road to the Channel ports, with the possibility, too, of a Channel tunnel or bridge. The Minister has pointed out that all new motorways and trunk roads have been designed for driving on either the left or the right, to facilitate a changeover in the future, and an inquiry is being made into this possibility.

Meanwhile, the traffic has to be handled. There were 4¼ million vehicles in 1951; there are over 8¼ million today; and the figure may double again by 1975.

of Driving Middle-Aged Cars off the Roads

Some slight relief of road congestion must already have been obtained from the compulsory testing of cars over ten years old, which came into force earlier this year. Further relief—though it will not be noticeable—will come from the Minister of Transport's proposal to reduce the age limit from ten to seven years. More important, these tests will encourage improved maintenance of motor vehicles.

Such encouragement is badly needed. Though the standard of driving ability has improved noticeably, even in the last ten years, the standard of maintenance has almost certainly fallen. People who owned cars between the wars were mostly those who took a personal interest in the care of their vehicles. Today there are many who, because they have no technical knowledge of their chariots, fight shy of even ensuring that their local garage does an adequate job. And many of them can barely afford to run a car, with the result that they skimp maintenance expenditure.

The owner-driver is responsible for seeing that his vehicle is properly maintained, but is enough being done to help him, and—as with the Ministry's tests—to compel him to discharge his responsibility? If the insurance companies had set up their own vehicle testing system, giving conscientious owner-drivers the benefit of a reduced premium, we might have been spared the need for Government action and expenditure.

Car manufacturers are alive to the sales value of designs which require less maintenance. The number of lubrication points and the frequency they require attention are being reduced. But in their handbooks and instructions they do not all make it easy for the layman to check that the maintenance work is done efficiently.

The garages are the weak link. Far too many have no system of inspection of the work of their own mechanics. It is time they took the same interest in quality control as do the manufacturers.

Not Enough Air Space

Air space over the United Kingdom is insufficient to meet the demands of the growing air traffic, except on a co-ordinated basis.

Even in a compact country like Britain, travelling by air has become desirable. A lack of good trunk roads has no doubt contributed to this, and the airlines can compete with the railways for comfort and price. Domestic trunk routes operated by BEA have been very successful, and the number of charter flights provided by the independent companies continues to rise. Business flying looks like expanding with the realistic future provided by the advent of Beagle aircraft, and flying clubs continue to increase their activities.

Air space becomes more and more precious and less easy to find. With this scarcity comes the need to see that it is more efficiently used, and to do this the Ministry of Aviation are carrying out in December a census of civil aircraft movements. The records of past activity in controlled air space have proved valuable in the development of the national airways system, but now that attention is being concentrated on the problems of flight in the uncontrolled regions, the lack of basic information is hampering progress in the planning of air traffic control systems.

For the census, owners of all British aircraft will receive a set of cards designed for completion in the air at each hour of the seven-day period. The cards will be posted back to the Ministry of Aviation for analysis. Special arrangements have been made for foreign aircraft.

Saturation in the air runs parallel with saturation at the airports, but here the answer may be to provide more satellite airports around the big cities, like Gatwick, Luton and Stanstead for London, to even out the flow.

and Not Enough Civil Engineering

Earlier this year, the value of the constructional work being carried out by British contractors within the British Isles was continuing to rise. With a slightly lower labour force, the index of production in the industry was running about 8 per cent higher than twelve months previously.

Mr. P. W. E. Holloway, chairman of the Federation of Civil Engineering Contractors, has pointed out that recently announced Government measures must impose a temporary restriction on the expansion of the industry. Continuous restrictions, he added, will have serious repercussions and, he concluded, "The main concern of the industry and of the Federation is that the controls should be removed as soon as possible."

If Britain joins the Common Market, the civil engineering industry will nominally have an opportunity for immense expansion, not merely on the Continent, but also in many countries overseas. Under the Rome Treaty three funds have been established which are fed by allocations from the member states, two of which will certainly be of value to contracting firms. First, there is the European Investment Bank, which has a capital of $1,000 million and is largely concerned with developing backward areas on the Continent, such as Southern Italy. Secondly, there is the Overseas Development Fund, which has $500 million to spend in the former colonial areas during the next five years.

Past experience of handling contracts overseas will give British firms many advantages in looking for this work. Though recent history has been coloured by the failure of British firms to win certain big contracts, any expansion in the volume of work to be undertaken can only be to the advantage of the British firms.

Moving on to the Continent itself may not be so easy. Civil contracts of any magnitude can only be conducted with a fair proportion of local labour, and the language problem will always bear more hardly on the British than on their Continental competitors. In reverse, however, Continental firms are likely to find British bylaws too difficult for them to compete.

Ergonomic Thinking in Crane Cab Design

Ergonomic principles were considered in the design of an overhead crane cab. Factors involved included the position of the cab along the crane girders, visibility, layout of the controls and the cab interior.

By R. G. Sell and A. W. Box, Operational Research Dept., BISRA, and K. Leyshon, of Joseph Booth and Brothers, Ltd.

AN EXCELLENT opportunity to put into practice some of the principles of crane design on which they had been working, recently came the way of the ergonomic team at the British Iron and Steel Research Association.

In 1958, Guest Keen and Nettlefolds approached BISRA to undertake an ergonomic analysis of a rod mill warehouse which might help in the designing of a crane just ordered from Joseph Booth and Brothers Limited. The fact that the crane would work in the same shop alongside an existing crane of an older type, raised the welcome possibility of comparing the two. The work called for close cooperation between the research workers of BISRA, the development engineers of GKN and the designers of Joseph Booth.

The Old Crane

The old crane has the task of picking up, by means of a tilting C hook, a number of coils of hot rods from a stand on one side of the warehouse, placing each batch on a weighbridge in the middle of the warehouse and then depositing the coils in a stockyard which extends over the whole width of the shop. The crane also picks up coils from the stockyard and loads them on to railway wagons or lorries for dispatch. The lorry loading bay and railway lines are on the opposite side of the warehouse from the stands where the coils are picked up. Sometimes coils are loaded onto the railway wagons directly after weighing. The cab of the old crane is shown in Fig. 1. The driver has to stand to operate the control handles which have a wide and awkward sweep. The cab is open at the front compelling the driver to lean over the edge of the cab to see the hook when picking up loads in front of the cab. The mechanical footbrake provided is difficult to operate from the driving position.

Ensuring Good Visibility

One of the most important points to be considered in designing a crane is ensuring that the driver, in his normal operating position, has an unobstructed view of his crane hook at all working points and a good all-round view of the shop. The main aspects to be considered are:

(*a*) Whether the driver is to operate the crane standing or sitting.
(*b*) The position of the crane cab on the crane girders.
(*c*) The design of the crane cab structure itself.
(*d*) The layout of the interior of the cab.

Items (*c*) and (*d*) above are, of course, not unconnected because in the design of the cab space must be left for the interior fittings and for access and maintenance.

The first question was thus whether the operator was to sit or stand permanently to drive the crane, or whether it should be possible for him to do either according to his mood. Ideally the second alternative is the best, but this entails either that the controls themselves should be adjustable so as to be always in the correct operating positions or that there should be a special high seat with an attached foot rest which could be slid back when the driver controls the crane from the standing position. A third alternative would be to provide a well in the floor for the driver to stand in. Because of the inevitable delay in delivery entailed by building in special arrangements of this kind it was decided to incorporate a BISRA anthropometric seat in the design as the best remaining alternative.

The position of the cab on the main girders was found with the aid of a small scale model ($\frac{1}{4}$ in to 1 ft) of the warehouse with all the structures likely to impede the driver's vision reproduced; also included was a mock up of the crane with a movable hook and a movable "cab" all built to scale. A light bulb was set at the eye level of a seated driver. The model was placed in a darkened room, and the lighted bulb shifted along the crane girders. Careful note was taken of the shadows cast by the various obstructions on the shop floor; this gave the area of the shop hidden from the driver's view with the cab in its various positions.

It soon became clear that the chief structure obstructing the driver's vision was the weighbridge cabin and, in order to give the driver an adequate view of the weighbridge itself, the cab had to be positioned on the weighbridge side of the cabin. It was eventually decided that the cab should be placed directly over the lorry loading bay and mid-way between the weighbridge and railway tracks so that the line of vision towards these latter points would be as far from the vertical as possible. The view directly downwards, required by the driver when loading lorries, was taken care of in the design of the cab itself.

The model was equally useful in tackling the problem of designing the cab structure to ensure maximum visibility. A thread was attached to the bulb and the crane was placed with its hook over the various working positions. With the thread stretched over the corners of the hook in these positions the angles were measured of the "cone of vision" required by the driver to obtain an unimpeded view of his hook and load at the critical working points. (See Fig. 2.)

Once the cones of vision had been plotted, the design of the cab became a reasonably straightforward matter of arranging the structural framework of the cab for minimum interference with the necessary field of view. These findings were forwarded to and later taken into account by the design engineers of Joseph Booth upon whom, of course, fell the major tasks connected with the structural design.

Layout and Type of Controls

The original specification called for seven-notch drum controllers for the tilt and cross travel and five-notch master controllers for the long travel and hoist. The actual controllers considered were all very large and would have tended to counteract the good visibility design of the cab; they also had the same wide and awkward sweeps of movement as the controllers in the old cab. Two ways were considered of overcoming these objections: firstly, by reducing the number of notches on the controllers to a minimum, and secondly, by placing the controllers themselves in the contactor room above the cab and operating them remotely by rod linkage—a layout which would entail having only the controller handles in the cab.

A test carried out on the long travel and hoist motions of the old crane indicated that a reduction in the number of speed steps to three or four would be possible, and a scheme of remote control was worked out. Visibility was not impeded with this arrangement and the handles were suitably geared so as to need only limited areas of movement. However, this

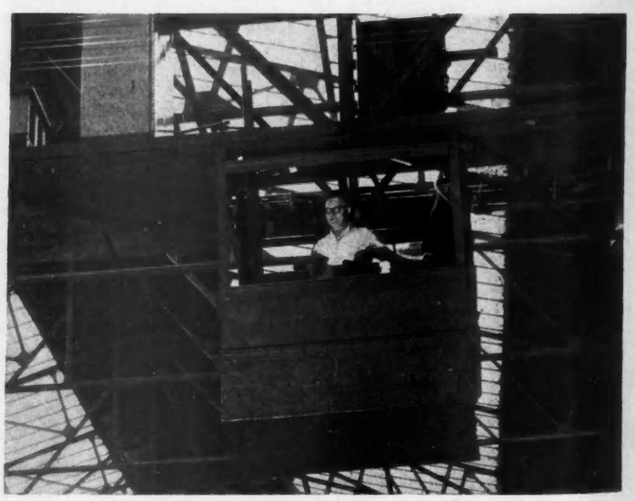


Fig. 1 (right) In the old crane the driver had to stand to operate the controls which had a wide and awkward sweep. In addition, he had to lean over the edge to see the hook when picking up loads in front of the cab.

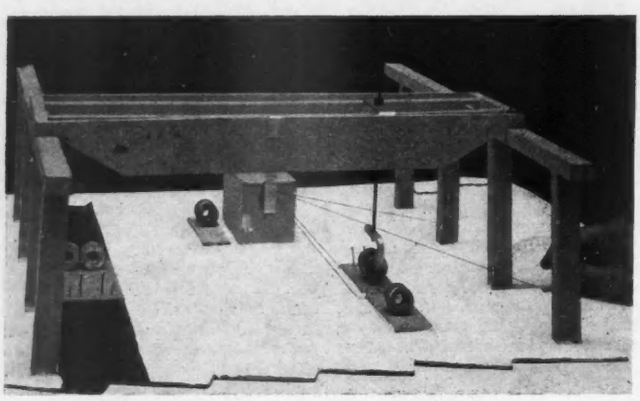


Fig. 2 (left) A $\frac{1}{4}$ in to 1 ft scale model was made of the warehouse with all the structures likely to impede the driver's vision reproduced. It helped to find the optimum position for the cab on the crane girders and also in designing the cab structure to give maximum visibility.

scheme had the disadvantage that, because of the gearing, the controller handles required large forces to operate them; this disadvantage was sufficient to make the scheme impracticable.

During subsequent discussions with GKN on this proposed layout it was decided to abandon the drum controllers and to install miniature master controllers with associated contactor panels for all motions. A new design was therefore prepared with the new type of master controllers arranged for dual operation; one control lever operated by the right hand for controlling the hoist and tilt and the other operated by the left hand for controlling the long and cross travels.

A small mock-up of the controls, set up in the laboratory, helped to determine the optimum positions of the two control knobs so that (i) they would be in convenient positions for all sizes of operators, (ii) adequate space would be left in front of the seat for the driver's legs and (iii) operation of the hydraulic brake would be possible; the foot brake is incorporated into the foot rest grill. The seat can be slid back to allow easy access and locks in the forward operating position when the operator is driving.

The New Crane

Figure 3 shows the new cab at work. The arrangement of the glass panels and of the supports allows an unobstructed view of the critical areas during loading and unloading, as well as ensuring good all round visibility of the shop. The angling of the front and side glass panels gives more room for access and—since the glass is nearly at right angles to the driver's line of vision—helps to avoid distortion and reflection. The floor of the cab is as narrow as compatible with allowing access and room for the seat and controllers; the view from the cab on all sides is thus extremely steep.

When loading lorries in the loading bay the driver is able to look directly downwards between his knees through the glass panel at the bottom of the cab; this bottom panel is angled to avoid dust and dirt lodging on the glass. The driver's feet rest on an angled grill just above the glass and the grill is hinged to allow for cleaning.

When the outside glass of the cab needs cleaning, the crane is run to the end of the shop where the cab comes to rest over the flat roof of a motor room. Failing this convenient though entirely fortuitous circumstance it would have been necessary to provide opening windows and the additional glazing bars needed would have reduced visibility. If the opening windows were of any appreciable size safety bars would be necessary to prevent the window cleaner from falling out and visibility would thus be further reduced. When new buildings are being built it would, therefore, be worth while installing a window cleaning platform from which all cranes in the shop can be cleaned.

The cab structures had to be made rigid at the points where glass was to be inserted into the frames, because any distortion of the frames would otherwise result in rupture of the armour glass especially at the weak edges. To provide this rigid framework, the structural members enclosing the front window on both sides incorporated steel plate arranged "edge on" to the driver's line of sight.

Fig. 3 The new crane cab at work. The arrangement for the glass panels and the supports allows an unobstructed view of the critical areas during loading and unloading.

Measurements taken of the heat conditions in the shop showed that sliding windows in the top half of the cab, which allow the air to circulate, would help to maintain a comfortable atmosphere and these were incorporated in the design.

Follow-up Inquiries

A visit was paid to the works six months after the crane had been installed. The working arrangements in the shop are such that each driver spends one week in four on the new crane and the other three weeks on the old crane. This does not allow them to get really used to the new one.

Visibility of the working points was reported to be very good. Two minor criticisms of the cab design were made: that it is not always easy to see to the rear and that the horizontal glazing bar immediately in front of the cab crosses the driver's line of vision when he is looking forward. We agree that another window in the rear of the cab would have been useful. Of course, this would have meant placing elsewhere some of the switchgear which is now on the back wall of the cab—a change which in itself appears desirable.

The seat installed in the cab is covered with a "pimply" rubber covering meant to allow the circulation of air between the driver and the seat. Unlike drivers in other works, the GKN drivers did not think this of value. On the whole, preference was expressed for operating the crane standing up because this affords more freedom. It seems that the ideal solution of designing the cab so that the crane could be operated either standing up or sitting down would indeed have been desirable.

The main outright criticism of the new crane was that it is too slow. This may be due in part to all the motions having contactor control and therefore slower acceleration; it may also be that the maximum speeds of the motor are too slow. One of the biggest difficulties which the drivers have in operating the new crane is learning to use the dual-motion joy stick controls. This is especially so with the hoist and tilt because any inadvertent operation of the tilt controller can result in the dropping of the load.

A recommendation was made to the company that if difficulties persist even after the drivers have been working on the crane for a long period then they should consider changing the hoist-tilt controller to two separate controllers.

Developing Internal Manufacturing Standards

Some aspects of standardization which can contribute to a reduction in manufacturing costs are discussed by Mr. J. E. Chadbund in Pametrada *News Letter No. 27*.

There is scope for development of the "internal" standards which exist in greater or lesser degree in all manufacturing organizations, and still further scope for rationalization, leading to specialization, as between manufacturers. Mr. Chadbund gives turbine blading—almost the only part of a turbine involving quantity production—and valves and fittings as examples amenable to standardization.

In an average tanker, there are about 2,200 valves and fittings in the machinery spaces, and a further 700 or so for the shipyard services. Some of these, such as high pressure steam valves, stop valves, emergency valves and manoeuvring valves, are often specified but in the remainder there is scope for standardization, and its derivatives, rationalization and specialization.

Disadvantages of standardization fall mainly into two groups: (1) the limitation of technical progress and cramping of initiative in design; (2) the restriction placed on the user's choice.

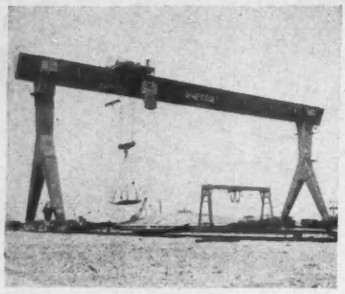
Standards tend towards "average" and an average has no actual existence but is only a mathematical concept. To arrive at an average there must be some designs better than standard and some not so good; and the only way to develop new and better standards is to ensure that a degree of flexibility is maintained, and that revision is so frequent as to prevent stagnation. The design standard may then be fairly described as "the current crystallization of the best known practice."

It is recognized that wide diversity must exist in the user's choice, and it is essential for the manufacturer to meet the varying requirements of the user. Within the framework set by the use of standard basic frame sizes, standard materials and components, there is room for a very great measure of individuality, relating to the conditions, limitations, performance and appearance as between manufacturers and there is no reason to fear that the special requirements of any user cannot be met.

There will always be room for the manufacturers who are prepared to make something different from their competitors and, in doing so, advance the standards of the whole industry.

Goliath Crane with Triangular Cross Beam

It is not easy to make a Goliath crane look attractive, but Carruthers have done so with the one they have installed for Whessoe Limited on the site of the Dungeness nuclear power station. The crane, which has a capacity of



The cross beam on this Goliath crane is a triangular section welded box girder.

40 tons and a span of 200 ft, will be used during the construction of the two reactor pressure vessels. Height of lift is 65 ft.

Notable on this crane is the cross beam which is a triangular section welded box girder. Such a section has the advantage of lower manufacturing costs, and lower structural weight than the more conventional rectangular sections. Carruthers made their first welded box girder crane in 1954 and since then have concentrated almost entirely on this type of structure.

J. H. Carruthers and Company Limited, East Kilbride, Glasgow.

Flat Belting for Hovercraft Drive

Much has been written about the Vickers VA-1 research hovercraft. The method of driving the fore and aft fans is interesting.

A standard endless Meteor belt type S20, 8½ in wide, made by Stephens Belting Company, was found to be suitable for propelling the lift fan propshaft. The conditions under which the drive had to operate were particularly arduous as, in addition to the reduction of speed, the belt was to be used as a clutch.

Another drive was needed to power the 6,500 rpm cooling fan for the 120 hp main engine. Here a standard Miraclo belt, type MT, 1 in wide, provided a satisfactory solution. Both belts were flat, of the nylon-core type and travel at 3,700 ft per min. The Meteor main drive belt transmits over 120 hp and the Miraclo belt which runs crossed, transmits 3 hp.

Large sums of money often have to be spent on research projects so it is worth noting that both belts together cost less than £20.

Stephens Belting Ltd., Snow Hill, Birmingham 4.

Furnace Uses No Firebrick

A stress relieving electric furnace measuring 27 ft sq. by 80 ft long is being installed at the Thornaby-on-Tees works of Head Wrightson Teesdale Limited. Believed to be the largest in the world, the furnace will be capable of stress relieving large fabrications such as oxygen steel converters and will be used in the fabrication of the boilers for the nuclear power station at Dungeness.

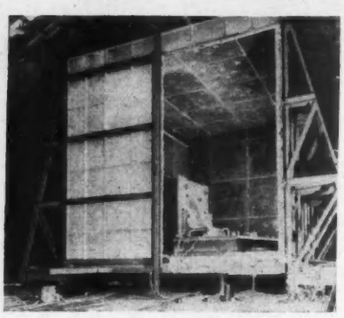
The hearth, walls and roof are constructed generally from 8 ft sq. mild steel panels which are filled with compressed mineral wool slabs and secured with flexible mild steel sheeting. Heating is by convection currents of hot air inside a closed furnace with no flue, therefore oxidization of fabrications is negligible. No firebrick is used anywhere in the furnace.

The lightweight high-efficiency mineral slabs need less heat than refractory bricks. The roof panels are affixed to longitudinal rolled steel joists at roof truss height. The side walls, carried by A frames and mounted on bogies, are easily retractable. The end walls can be lifted into position in two sections by a mobile crane.

1,500 kW electrical elements, at mains voltage, are arranged in 40 kW units, each unit comprising 12 coiled elements in sintered alumina sleeves supported in stainless steel channels. The channels rest on mild steel framework which is placed on the floor of the furnace.

Fabrications to be stress relieved are supported on cradles and carried on bogies which carry the furnace floor, also made in panel form. Longitudinal expansion is taken up by individual bogies which move relative to each other. The furnace has been designed so that it can be readily dismantled and re-erected elsewhere or suitably modified to admit smaller or larger fabrications.

A 40 ft length of the furnace is now complete and in this section a fabrication was stress relieved within the limits of 610° C minimum and 630° C maximum. Furnace panels and electroheat units were supplied by the designers of the furnace, Cooper Electroheat, and Head



First completed section of the 27 ft square stress relieving furnace.

Wrightson Teesdale made and installed the bogies and the supporting structure.

Head Wrightson Teesdale Limited, Thornaby-on-Tees, Yorks.

Cooper Electroheat Limited, 164 Lord Street, Southport, Lancs.

Distillation Plant Supplied in Sections

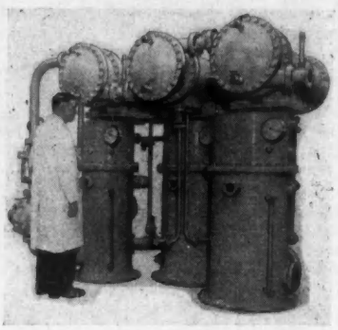
A range of flash distillation plants for marine use that can be provided in small, low-weight sections in order to facilitate installation has been designed by Buckley and Taylor Limited. Known as the Aquaflash AF2, the plant is a new version of the company's standard marine Aquaflash plant.

One of the disadvantages of normal flash plant is its bulk installation requirements. Lowering a normal flash plant of rectangular box construction to its seating low down in the engine room can be a costly undertaking when pipework and other auxiliaries have to be moved. Buckley and Taylor have given special consideration to this replacement problem and it is for this reason that the AF2 design was developed.

Each flash chamber is supplied as a separate fabrication and simple circular chambers are used. Each vapour condenser is also supplied separately ready for assembly on top of its associated flash chamber. A wide variety of installation arrangements are possible with the design.

For instance, in cases where there are two possible locations available for a distiller, neither of which is sufficiently large to house the complete plant, the AF2 can be split into sections with connecting pipes, thus making the best possible use of whatever space is available. The plant can therefore be packaged or split into separate components and distributed around the engine room to utilize any otherwise wasted space.

In its packaged form, the size is about the same as that of the company's AF1 box construction plant. The standard range of capacities is from 25 to 50 tons of distillate daily. Other sizes can be made to order. The makers claim that these units are ideally suited for marine use as they are extremely economical and low in capital cost. They can operate on almost any



A wide variety of installation arrangements are possible with this design.

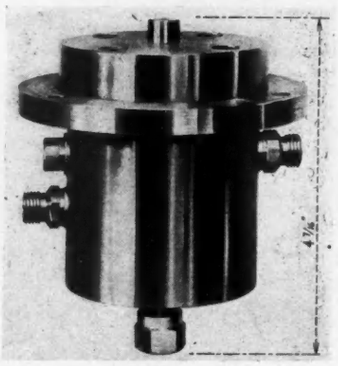
source of waste heat (steam, hot water or exhaust gases); they can be quickly started up and are easy to operate; they are self regulating and scaling is said to be negligible.

Buckley and Taylor Limited, Castle Iron Works, Oldham, Lancashire.

Hydraulic Tension Controller

A hydraulically operated tension control device for any kind of fast moving web, including extensible plastic, has been designed for use with machines having an existing hydraulic drive.

The web passes over a sensing roller which is linked to a tension controller. The controller has a pre-set loading and will detect any variation in web tension which causes a movement of 0·005 in or more of a thrust pin. A hydraulic signal is fed from the controller to a servo-operated relief valve, which in turn regulates the oil pressure fed to the hydraulic motor driving the next section of the machine after the



Hydraulic tension controller can sense slight variations in web tension.

controller. The web tension is thus constantly under inspection and all conditions which affect it are catered for, whether due to changes in machine speed or variations of load due to changes in reel diameter during rewind or off-wind.

The makers say that in spite of the system's sensitivity it does not give tension flutter nor does it hunt. Servo oil pressure can be supplied by a small pump built on to the main hydraulic pump.

Hydraulic Machinery Drives Limited, 101 London Road, Reading, Berks.

Plain Words

By Capricorn

AN IDEAL is shattered. The shorter working week, I read in an American magazine, is no longer a goal of American trade unions—" it is dead as a practical issue."

It seems that employers in the United States, concerned about the rising cost of labour, just won't listen to a demand for a cut in working hours with no reduction in pay. Also, unemployment—often used as an argument for a shorter working week so as to spread the available work—is not as high as it was. Above all, President Kennedy has said: " I am hopeful that we can have employment high five days a week, and 40 hours, which is traditional in this country, and which is necessary if we are going to continue economic growth . . . I would be opposed to any arbitrary reduction of the work week."

It used to be said that what Manchester thinks today, London thinks tomorrow. I hope that neither the people of the United States nor Mancunians will resent the analogy, but I have noticed that what the USA thinks today, a large part of the rest of the world thinks tomorrow. So I can see this new view of the shorter working week catching on. I can see the industrial countries of the world leaving the path to debauchery and voluptuous living on which their high standards of living had set them. Not for Americans the decline that was Rome's. The industrial nations will become the industrious nations.

It must be quite a long time since we were first told that Man was moving steadily towards greater leisure. It has been a pleasant day-dream to think of our children having a week-end that would be longer than the working week, or having three months holiday a year, and occasionally having a whole year off from work to do a grand tour. The ideal of a shorter working week has given us something to work for.

Of course the dream was often spoilt by Jeremiahs who prophesied a headlong decline in our moral standards and bewailed the frivolous pursuits of the masses. But their gloom was at other times dispelled by the bright-eyed but muddled-thinking optimism of another group of do-gooders—those who saw a glorious opportunity to convert mankind to the doctrines of their particular sect. They saw themselves as saviours of their fellows—especially the fellows who were less intelligent or less wealthy than themselves.

But this is all past now. We won't have increased leisure. We are going to go on working.

What a relief ! Perhaps now we'll be frank and say what has been on our minds for a long time—that we like work, and the more we put into it the better we feel. Perhaps we'll join the demonstrators from Derby who paraded in London with placards to say they were happy in their work.

Those eighteen gallant demonstrators could do with more support from ordinary workers —they themselves are all employed in a dance hall.

Letters to the Editor

When is a Gramophone?

SIR, In a recent At Home " Tape and Phone " (ENGNG., 15 Sept. '61, p. 364), you describe a new product (the Super Ten) as a gramphone, yet I gather from the description that it is necessary to have an amplifier or radio set to use it as one.

Having for years had to wonder every time I see a record-player advertised whether it is just a record-player or a full gramophone, I am perturbed at the thought that now I shall have to wonder every time I see a gramophone mentioned whether it is really a gramophone or only a record-player.

Please can you not give a lead in helping to keep these two different terms for the two different objects?

Yours faithfully,
ANTHONY E. BROOKS.

Sutton, Surrey.
10 October, 1961.

Night Use of Electricity

SIR, In your recent Impact (ENGNG., 13 Oct. '61, p. 461) reference is made to the night use of electricity and the recent report of the Electricity Council.

I note that the CEGB are now introducing a cheap night tariff as a direct incentive to increase the use of electricity at night and to encourage the work of the area Boards in an effort to improve the present load factor of 48·5 per cent. The running part of this tariff is 0·47*d* (the CEGB to area Boards) from 11 p.m. to 7 a.m. In this district, off-peak times operate from 6 p.m. to 7 a.m., Monday to Friday; so time clocks would have to be programmed for the two steps or an average rate charged to the consumer. But will the concession be passed on? I doubt it. The fixed charge part of the tariff has just been increased by 15 per cent.

The weak point is that " The onus is now placed on the area Boards to encourage the use of electricity at off-peak times." There should be a directive, not a pious resolution. As I said in an earlier letter (ENGNG., 24 Feb. '61, p. 276) too much is left to the individual area Boards; some are alive and go out to drum up business (Woking has 46 all-electric houses in a clean-air colony) while the others wait for it to come to them.

When I see a full window display on electric space heating directed to architects, builders, and the buying public in the local showrooms, then I shall believe that the electric interests are really on the move. With the onset of winter, the National Coal Board are running a national press campaign to perpetuate the coal fire, that relic of the Dark Ages, and the Gas Council are running another on warmed-air heating.

But, from the electric advertisements, it seems we have only got as far as the immersion heater in a coal-fired water tank !

Yours faithfully,
A. M. GUNNER.

Rugby.
13 October, 1961.

Events in Advance

A Flood of Paper

RECOGNIZING that the welter of paperwork with which offices are now being flooded is still on the increase, the British Institute of Management have organized a one-day conference to discuss the problems involved.

This event will be held, under the title " Efficiency in the Office," at the Connaught Rooms, Great Queen Street, London WC2, on 23 November next, from 9.45 a.m. to 5 p.m. That the amount of paper reaching most offices is excessive and needs additional staff, equipment and accommodation to deal with it, resulting in increases in costs, is generally realized. The forthcoming conference will endeavour to determine such questions as what information do managers really need to discharge their functions properly, and whether or not they are obtaining more information than they actually require.

Subjects to be discussed will include " The Office and Its Opportunities for Contributing to Management," by Mr. W. F. Brackman, Gillette Industries Limited; " Organization and Methods as an Aid to Efficiency," by Mr. L. A. Hill, Shell International Petroleum Company Limited; and " Automation in the Office," by Mr. W. H. Matthews, Urwick Diebold Limited. " The Human Aspect " will be covered by Mr. John Marsh, the new director of the British Institute of Management, and Mr. R. D. Young, assistant managing director of Tube Investments Limited, will be the conference's chairman.

The conference is intended to have a special appeal for directors, senior managers and accountants who wish to examine more fully the changed functions performed by office workers These executives are no longer engaged solely upon the handling of routine paperwork but, on the contrary, are largely concerned with the more complex administrative services which provide all levels of management with the information it needs for the planning and control of business.

For additional information, application should be made to the Director, British Institute of Management, 80 Fetter Lane, London EC4. (Telephone: HOLborn 3456.)

Exhibitions and Conferences

Arranged in chronological order

Magnetism and Magnetic Materials, Conference.—Mon., 13 Nov., to Thurs., 16 Nov., at the Hotel Westward Ho, Phoenix, Arizona, USA. Organized by the American Institute of Physics and the Institute of Radio Engineers. Apply to Mr. P. B. Myers, Motorola Semiconductor Products Division, 5,005 East McDowell Road, Phoenix, Arizona, USA.

Drawings for Building, Conference.—Thurs. and Fri., 16 and 17 Nov., at Olympia, London W14, in connection with the Building Exhibition (15 Nov. to 29 Nov.). Apply to the conference secretary, 11 Manchester Square, London W1. Tel. HUNter 1951.

Engineering, Scientific and Technical Film Festival, Second International.—Thurs., 16 Nov., to Sat., 25 Nov., in Budapest, Hungary. This festival will coincide with a conference of the popular scientific section of the International Scientific Film Association. In the United Kingdom, further information may be obtained from Hungarian News and Information Service, 167 Kensington High Street, London W8 (Tel. WEStern 9561); and the Scientific Film Association, 3 Belgrave Square, London SW1. Tel. BELgravia 6188.

Design of Equipment for Human Use, Course on.—Mon., 20 Nov., to Fri., 1 Dec., at Engineers' House, Bristol 8. Organized by the Engineering and Allied Employers' West of England Association, Engineers' House, The Promenade, Clifton Down, Bristol 8. Tel. Bristol 3-9131.

Display Production and Screen Printing Exhibition and Product Fair.—Mon., 27 Nov., to Fri., 1 Dec., at Washington Hotel, Curzon Street, London W1. Organized by the Display Producers and Screen Printers Association, 28 Ely Place, Holborn Circus, London EC1. Tel. HOLborn 1746.

Smithfield Show and Agricultural Machinery Exhibition.—Mon., 4 Dec., to Fri., 8 Dec., at Earl's Court, London SW5. Organized by the Smithfield Show Joint Committee, c/o Society of Motor Manufacturers and Traders, Forbes House, Halkin Street, London SW1. Tel. BELgravia 6611.

Sintered High Temperature Compounds, Symposium.—Thurs. and Fri., 7 and 8 Dec., at Church House, Great Smith Street, London SW1. Winter meeting of the Powder Metallurgy Joint Group of the Iron and Steel Institute and the Institute of Metals. Apply to the secretary, Powder Metallurgy Joint Group, 17 Belgrave Square, London SW1. Tel. BELgravia 3291.

Meetings and Papers

The address and telephone number of the headquarters of each institution are given at the end of this list. Meetings in the headquarters town are held there unless otherwise stated.

Association of Supervising Electrical Engineers

CROYDON
"Navigation Lights—Manufacture and Servicing", by A. F. Burn. South London Branch. Greyhound Hotel, Croydon, Surrey. Thurs., 26 Oct., 8 p.m.

British Institution of Radio Engineers

LONDON
"The Teaching of the Theory of Transistors and Other Semiconductor Devices", by Professor M. R. Gavin. Arranged by the Education and Training Committee. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Wed., 1 Nov., 6 p.m.
MALVERN
"Transistor Portables", by R. A. Lampitt. South Midlands Section. Winter Gardens, Malvern. Thurs., 2 Nov., 7 p.m.
MANCHESTER
"Very-High-Frequency Communications Receivers and Transmitters Using Transistors", by A. J. Rees and D. C. Carey. North Western Section. College of Technology, Manchester. Thurs., 2 Nov., 7 p.m.
WOLVERHAMPTON
"Electronics in Biological Engineering", by W. J. Perkins. West Midlands Section. College of Technology, Wolverhampton. Wed., 1 Nov., 7 p.m.

Illuminating Engineering Society

EDINBURGH
"The Association of Light and Colour", by A. D. Charters. Edinburgh Centre. YMCA, 14 South St. Andrew Street, Edinburgh. Wed., 1 Nov., 6.15 p.m.
NEWCASTLE UPON TYNE
"A Symposium on Office Lighting", by J. K. Boud and E. B. Sawyer. Newcastle upon Tyne Centre. Percy Building, King's College, Queen Victoria Road, Newcastle upon Tyne. Wed., 1 Nov., 6.15 p.m.
NOTTINGHAM
"Traffic Signals", by B. M. Cobbe. Nottingham Centre. Electricity Centre, Carrington Street, Nottingham. Thurs., 2 Nov., 6 p.m.

Institute of Marine Engineers

LONDON
"The First Principles of the Diesel Engine and Its Development for Use in Marine Work", by G. S. Mole. Student Lecture. Mon., 6 Nov., 6.30 p.m.
NEWCASTLE UPON TYNE
"Pollution of the Sea by Oil", by E. Douglas and I. G. Elliott. North East Coast Section. Stephenson Building, King's College, Claremont Road, Newcastle upon Tyne. Thurs., 2 Nov., 6.15 p.m.

Institute of Metals

LONDON
"The Design of Strong Materials", by A. H. Cottrell. London Local Section. Royal School of Mines, South Kensington, SW7. Thurs., 2 Nov. 7 p.m.
SWANSEA
"Hot Extrusion of Non-Ferrous Metals", by Professor A. R. E. Singer; and "Hot Extrusion of Steel", by R. Cox. South Wales Local Centre. Swansea and District Metallurgical Society. Metallurgy Department, University College, Swansea. Tues., 7 Nov., 6.30 p.m.

Institute of Petroleum

LONDON
"Molybdenum Disulphide as a Lubricant Additive in Rolling Contact: A Study of Compatibility with Other Additives", by D. Scott and D. Jamieson. Wed., 1 Nov., 5.30 p.m.

Institute of Refrigeration

LONDON
"Modern Designs in Thermostatic Control for Refrigeration, Including Air Conditioning, Automatic Defrosting and Heat Pump Applications", by J. E. Kumler. The National College for Heating, Ventilating, Refrigeration and Fan Engineering, Borough Polytechnic, Borough Road, SE1. Thurs., 2 Nov., 7 p.m.

Institution of Agricultural Engineers

EXETER
Brains Trust Meeting. South Western Branch. Royal Clarence Hotel, Exeter. Fri., 3 Nov., 7.30 p.m.

Institution of Civil Engineers

LONDON
"Western Avenue, Lagos; The Design and Construction of a Soil Cement Pavement" by C. M. Johnston. Tues., 31 Oct., 5.30 p.m.
"Foundation Design and Construction"; Informal Discussion, to be opened by D. J. Henkel. Thurs., 2 Nov., 5.30 p.m. Presidential Address, by Sir George McNaughton. Tues., 7 Nov., 5.30 p.m.

Institution of Electrical Engineers

LONDON
"Generation of Power in Satellites", by H. J. H. Sketch. Institution of Electrical Engineers and Royal Aeronautical Society London Joint Group. Wed., 1 Nov., 6 p.m.
Special General Meeting. For Corporate Members only. Thurs., 2 Nov., 5 p.m.
"Acoustics and the Electrical Engineer", by T. Somerville. Thurs., 2 Nov., 6 p.m.
"Information Theory in Relation to Biology"; Discussion, to be introduced by Professor D. M. Mackay. Medical Electronics Discussion Group. Fri., 3 Nov., 6 p.m.
"The General Problems of F. M. Multi-Channel Communications", by R. G. Medhurst. Electronics and Communications Section. Mon., 6 Nov., 5.30 p.m.
GLASGOW
"Some Notes on the Electrical Requirements of General Cargo Docks", by E. R. Radway. South West Scotland Subcentre. Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C2. Wed., 1 Nov., 6 p.m.
LEEDS
"Blaenau Ffestiniog and Other Medium-Head Pumped Storage Schemes in Great Britain", by H. Headland. North Midland Centre. The University, Leeds. Thurs., 2 Nov., 6.30 p.m.
NEWCASTLE UPON TYNE
"Potentialities of Artificial Earth Satellites for Radiocommunication", by W. J. Bray; and "The Interdependence of Civil and Electrical Engineering on the Continent Today", by F. C. Greenfield. North Eastern Centre. Conservative Club, Pilgrim Street, Newcastle upon Tyne. Wed., 1 Nov., 7 p.m.
SOUTHAMPTON
"Brushless Variable-Speed Induction Motors Using Phase-Shift Control", by Professor F. C. Williams, Dr. E. R. Laithwaite, J. F. Eastham and W. Farrer. Southern Centre. The University, Southampton. Wed., 1 Nov., 7 p.m.

Institution of Electronics

LEEDS
"Electronic Topics", films. Leeds College of Technology, Calverley Street, Leeds 1. Thurs., 2 Nov., 7 p.m.
LIVERPOOL
"Electronic Topics", films. Radiant House, Bold Street, Liverpool 1. Fri., 3 Nov., 7 p.m.
MANCHESTER
Various short papers and films. Manchester College of Science and Technology, Sackville Street, Manchester 1. Fri., 27 Oct., 7 p.m.

Institution of Engineering Designers

NEWCASTLE UPON TYNE
"A National Standard in Engineering Design Education", by W. A. A. Witham. North East Branch. Rutherford College of Technology, Northumberland Road, Newcastle upon Tyne. Mon., 13 Nov., 7.15 p.m.

Institution of Heating and Ventilating Engineers

LONDON
"Basic Principles of Control Application, with Explanation of a Complex Job Breakdown", by D. H. Powell and C. W. Spangle. Institution of Mechanical Engineers, 1 Bridcage Walk, St. James's Park, SW1. Wed., 1 Nov., 6 p.m.
LEICESTER
"Warm Air Curtains", by J. N. Saunders. East Midlands Branch. College of Technology, Leicester. Wed., 1 Nov., 6.30 p.m.
MANCHESTER
"Warm Air Curtains", by J. N. Saunders. Manchester Branch, Engineers' Club, Albert Square, Manchester. Fri., 3 Nov., 6.30 p.m.

Institution of Highway Engineers

LONDON
"The Economic Justification of Roads", by C. T. Brunner. Institution of Structural Engineers, 11 Upper Belgrave Street, SW1. Fri., 3 Nov., 5.30 p.m.

Institution of Mechanical Engineers

LONDON
"The Extent to Which Data Can Be Made Available for Engineering Design": General Discussion. Thermodynamics and Fluid Mechanics Group. Mon., 30 Oct., 6. p.m.
"Problems of Maintenance in the Petroleum and Kindred Industries": General Discussion. Process Engineering, Refrigeration, Ventilation and Vacuum Plant Group. Thurs., 2 Nov., 6 p.m.
BIRMINGHAM
"Management in a Competitive World", by W. J. Carron. Midland Branch. Matthew Boulton Technical College, Suffolk Street, Birmingham. Thurs., 2 Nov., 6.30 p.m.
BRIGHTON
"Machine Tool Research Design and Utilization", by Dr. D. F. Galloway. Southern Branch. Adelphi Hotel, Brighton. Thurs., 2 Nov., 7.30 p.m.
DUNDEE
"Closed-Cycle Gas-Turbine Development for Low-Grade Fuels", by Wm. Connell. Scottish Branch. Technical College, Dundee. Fri., 3 Nov., 7.30 p.m.
GLASGOW
"Closed-Cycle Gas-Turbine Development for Low-Grade Fuels", by Wm. Connell. Scottish Branch. Royal College of Science and Technology, Glasgow. Thurs., 2 Nov., 7.30 p.m.
LIVERPOOL
"Blade Profiles for Axial-Flow Fans, Pumps, Compressors, etc.," by Professor A. D. S. Carter. North Western Branch. Walker Lecture Theatre, The University, Liverpool. Wed., 1 Nov., 6.30 p.m.
MANCHESTER
"Potentialities of Accurate Measurement and Automatic Control in Engineering Manufacture", by J. Loxham. North Western Industrial Administration and Engineering Production Group. Engineers' Club, Albert Square, Manchester. Thurs., 2 Nov., 6.45 p.m.
NEWCASTLE UPON TYNE
"Metallurgy in Relation to Mechanical Engineering", by J. A. Brown. North Eastern Branch. Neville Hall, Westgate Road, Newcastle upon Tyne. Mon., 6 Nov., 6 p.m.

Institution of Production Engineers

LIVERPOOL
Film Evening. Liverpool Graduate Section. Walker Art Gallery, Liverpool. Thurs., 2 Nov., 6.30 p.m.
NOTTINGHAM
"Fabrications in Aircraft Gas Turbine Engines", by W. E. Corbitt. Reform Club, Victoria Street, Nottingham. Wed., 1 Nov., 7 p.m.

Institution of Structural Engineers

BIRMINGHAM
"Proposed Bridge over the English Channel", by Dr. A. R. Flint. Midland Graduates' and Students' Section. Engineering Centre, Stephenson Place, Birmingham 2. Fri., 3 Nov., 6.30 p.m.

Junior Institution of Engineers

LONDON
Technical Film Evening. Fri., 3 Nov., 7 p.m.

Liverpool Engineering Society

LIVERPOOL
"Gas in Industry on the Merseyside", by H. C. Elles. Joint Meeting with the Institute of Fuel. Wed., 8 Nov., 6 p.m.

Manchester Metallurgical Society

MANCHESTER
"Problems Associated with the Welding of Heavy Sections", by A. F. Gifford. Joint Meeting with the Manchester Branch of the Institute of Welding. Manchester Literary and Philosophical Society, George Street, Manchester. Wed., 1 Nov., 7.15 p.m.

Newcomen Society

LONDON
"Gaspard Monge (1746 to 1818) and His Effect on Engineering Drawing and Technical Education", by P. J. Booker. Wed., 1 Nov., 5.30 p.m.

North East Coast Institution of Engineers and Shipbuilders

NEWCASTLE UPON TYNE
"Aspects of Research in Marine Engineering", by Dr. A. W. Davis. Andrew Laing Lecture. Literary and Philosophical Society, Newcastle upon Tyne. Mon., 30 Oct., 6.15 p.m.

Presentation of Technical Information Group

LONDON
"Recent Developments in Information Retrieval", by A. H. Holloway. Malet Place entrance, New Engineering Block, University College, Malet Street, WC1. Tues., 24 Oct., 6.15 p.m.

Radar and Electronics Association

LONDON
"Space Communications". Part II, "Orbits and Their Economics", by Dr. W. F. Hilton. Royal Society of Arts, John Adam Street, Adelphi, WC2. Thurs., 9 Nov., 7 p.m.

Reinforced Concrete Association

LIVERPOOL
"Code of Practice Relating to Water Retaining Structures", by A. W. Hill. North Western Branch. Liverpool Engineering Society, 9 The Temple, 24 Dale Street, Liverpool. Tues., 7 Nov., 6.30 p.m.

Royal Meteorological Society

LONDON
"Giant Hail", by Dr. F. H. Ludlam. Wed., 1 Nov., 5.30 p.m.

Royal Statistical Society

LONDON
"Computers in Medicine" Open Discussion, to be summed up by Dr. F. Yates. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Tues., 31 Oct., 5.30 p.m.

Sheffield Metallurgical Association

SHEFFIELD
"Casting in a Vacuum", by L. S. Taylor. BISRA Laboratories, Hoyle Street, Sheffield. Tues., 31 Oct., 7 p.m.

Society of Chemical Industry

LONDON
"The Industrial Water and Effluents Group", by Dr. B. A. Southgate. Inaugural Meeting of the Society's Industrial Water and Effluents Group. Royal Institution, Albemarle Street, W1. Wed., 1 Nov., 6.45 p.m.

Society of Instrument Technology

LONDON
"Semiconductor Diodes and Rectifiers in Control Engineering", by P. R. Wyman; and "The Transistor in Control Engineering", by Dr. G. D. Bergman. Control Section. Manson House, Portland Place, W1. Mon., 6 Nov., 7 p.m.
BIRMINGHAM
"The Mathematics of Process Control", by P. G. Farley. Midland Section. Gosta Green College of Technology, Aston Street, Birmingham. Fri., 10 Nov., 7 p.m.
GLASGOW
"Variable Area Flowmeter Sheds Its Limitations", by N. Nixon. Scottish Section. Scottish Building Centre, Sauchiehall Street, Glasgow. Fri., 27 Oct., 7.15 p.m.
LEEDS
"Modern Instrumentation Applied to Gas Distribution", by H. S. Horn. South Yorkshire Section. Metropole Hotel, Leeds. Wed., 1 Nov., 7 p.m.
MIDDLESBROUGH
"Symposium of Modern Instrument Maintenance":—"Job Methods and Scheduled Maintenance", by J. R. Gordon; "Organizing the Work of a Maintenance Section", by J. Dunkley; "Keeping Maintenance Costs to a Minimum", by D. M. Bishop; and "Test Equipment for Maintenance Purposes," by G. White. Cleveland Scientific and Technical Institution, Middlesbrough. Thurs., 9 Nov., 7.30 p.m.

Association of Supervising Electrical Engineers, 23 Bloomsbury Square, London WC1. (LANgham 5927)
British Institution of Radio Engineers, 9 Bedford Square, London WC1. (MUSeum 1901)
Illuminating Engineering Society, 32 Victoria Street, London SW1. (ABBey 5215)
Institute of Marine Engineers, Memorial Building, 76 Mark Lane, London EC3. (ROYal 8493)
Institute of Metals, 17 Belgrave Square, London SW1. (BELgravia 3291)
Institute of Petroleum, 61 New Cavendish Street, London W1. (LANgham 3583)
Institute of Refrigeration, New Bridge Street House, New Bridge Street, London EC4. (CENtral 4694)
Institution of Agricultural Engineers, 6 Queen Square, London WC1. (TERminus 0140)
Institution of Civil Engineers, Great George Street, London SW1. (WHItehall 4577)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London WC2. (COVent Garden 1871)
Institution of Electronics, 78 Shaw Road, Thornham, Rochdale, Lancs. (Oldham Main 6661)
Institution of Engineering Designers, 38 Portland Place, London W1. (LANgham 8847)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London SW1. (SLOane 3158)
Institution of Highway Engineers, 47 Victoria Street, London SW1. (ABBey 3891)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London SW1. (WHItehall 7476)
Institution of Production Engineers, 10 Chesterfield Street, London W1. (GROsvenor 5254)
Institution of Structural Engineers, 11 Upper Belgrave Street, London SW1. (SLOane 7128)
Junior Institution of Engineers, Pepys House, 14 Rochester Row, London SW1. (VICtoria 0786)
Liverpool Engineering Society, 9 The Temple, 24 Dale Street, Liverpool 2. (Central 3717)
Manchester Metallurgical Society. Apply to Mr. E. Holland, The Kennedy Press, Ltd., 31 King Street West, Manchester 3.
Newcomen Society, Science Museum, Exhibition Road, London SW7. (KENsington 1793)
North East Coast Institution of Engineers and Shipbuilders, Bolbec Hall, Newcastle upon Tyne 1. (Newcastle 20289)
Presentation of Technical Information Group. Apply to Mr. B. C. Brookes, University College London, Gower Street, WC1.
Radar and Electronics Association, 45-47 Mount Street, London W1. (GROsvenor 4477)
Reinforced Concrete Association, 94-98 Petty France, London SW1. (ABBey 4504)
Royal Meteorological Society, 49 Cromwell Road, South Kensington, London SW7. (KENsington 0730)
Royal Statistical Society, 21 Bentinck Street, London W1. (WELbeck 7638)
Sheffield Metallurgical Association, 64 Crescent Road, Sheffield 7. (Sheffield 52865)
Society of Chemical Industry, 14 Belgrave Square, London SW1. (BELgravia 3681)
Society of Instrument Technology, 20 Queen Anne Street, London W1. (LANgham 4251)

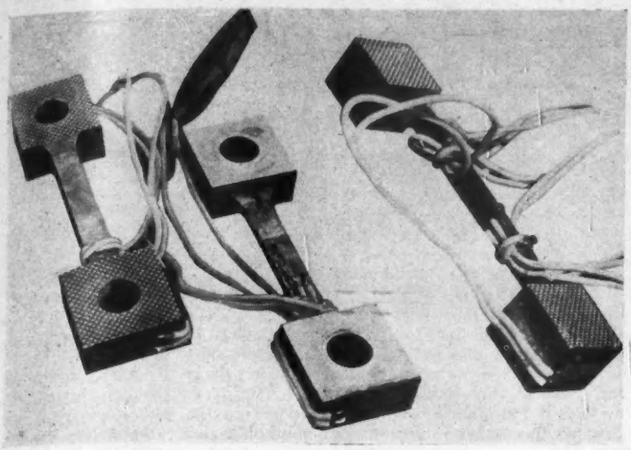


Fig. 1 (left) Strain links. Bolted links are shown on the left and centre, clamped on the right.

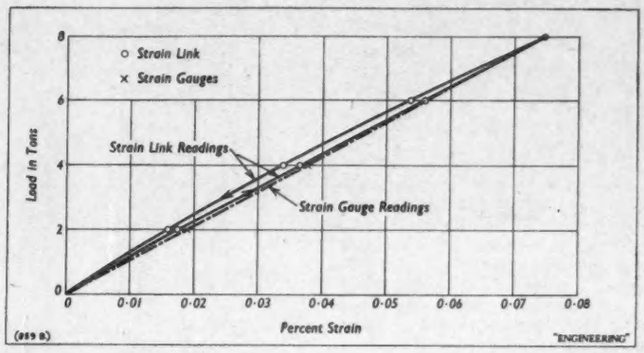


Fig. 2 (above) Calibration of strain link on a tensile testing machine. (First load cycle only).

Strain Links for Strain Gauging Outdoors

To overcome the difficulties of weatherproofing electrical resistance strain gauges for use in exposed places out-of-doors, the CERL have developed strain links which are prepared in advance and clamped or bolted into position just prior to testing.

By K. E. Easterling

Central Electricity Research Laboratories

In the application of the electrical resistance strain gauge under outdoor conditions, care must be taken to ensure that the gauges are unaffected by weather conditions. Those who have used strain gauges will know the effect on them of moisture and temperature changes, and in fact how these effects can be prevented. However, if preventative measures are to be successful, three to four days must elapse between the first preparation of the gauges and final weatherproofing. In exposed conditions during winter months as long as two weeks have been necessary to adequately strain gauge the stubs of a transmission tower for foundation and overturning tests.

To overcome these difficulties, special strain links have been designed and developed at the Central Electricity Research Laboratories that may be bolted or clamped in position immediately prior to use. These links give the same sensitivity and accuracy as the normal resistance strain gauge application. Such links have been used for two tower overturning tests in South Wales, and for the measurement of structural strains due to conductor oscillation at a height of 500 ft over the River Severn.

Design Considerations

The links were designed to be as sensitive and accurate as gauges applied conventionally, while being weatherproof, as small and as cheap as possible, and easy to fit in the required position.

Fig. 1 shows two forms of the finished link, for use where either bolting or clamping is most appropriate. Provided there is enough force when bolting or clamping for the square pointed pyramids of the heads to penetrate the material under test, there is no advantage of one type over the other. The overall length of the link is determined by the stress distribution in the shank, and is a function of head design and length of strain gauge used. The section area of the link depends on the friction force available at the heads and the magnitude of the expected strain, and must be chosen with the intended application in mind to avoid interference with the strained member. If reasonable point-penetration is obtained and the specimen is large compared with the link there is no reason why the section should not be large enough to ensure good overall strength for machining and handling purposes.

A feature of the design should be that the centre section of the link is close to the object under test, thereby giving greatest sensitivity and eliminating errors due to bending. In both the cases illustrated here, the overall length of the link is 5 in, the heads are $1\frac{1}{4}$ in square, and the section at the link centres is $\frac{1}{8}$ in by $\frac{1}{4}$ in; the link is made from high tensile steel. It should be of a harder material than the object under test to ensure adequate penetration of the heads and to prevent the points losing their sharpness, thus making it possible to use the links again. The active gauge is mounted at the link centre and the temperature compensating gauge in an unstrained position on one head, the two gauges forming one half of the measuring bridge.

The gauges used (Advance wire in Bakelite) were selected for their moisture resistant properties, and are bonded and waterproofed with an epoxy resin. The gauges are temperature cycled and cured in a laboratory oven. Short lengths of lead are soldered and joints waterproofed in the laboratory.

Calibration

For the purposes of calibration and load cycling, prior to the site work carried out so far, the links were bolted to a calibration bar and fitted into a tensile testing machine. The calibration bar was of $1\frac{1}{2}$ by $\frac{1}{2}$ in section and, for direct comparison, another set of gauges was mounted on the bar alongside the link. The results are shown in Fig. 2 for the first load cycle only, and the hysteresis of the link strains was reduced after three further cycles. The link and gauges are shown to compare closely even for the first load cycle, and from the results of

Fig. 3 (left) Bolted strain link in position. The effect of penetration can be seen where a link has been removed from the side of the member under test.

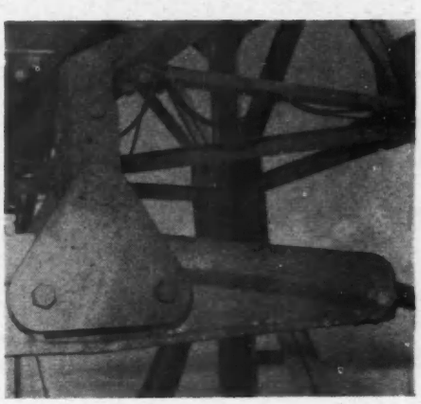


Fig. 4 (right) Clamped link in position over an earth wire cradle forming part of the 275 kV connection over the River Severn between Aust and Beachley.

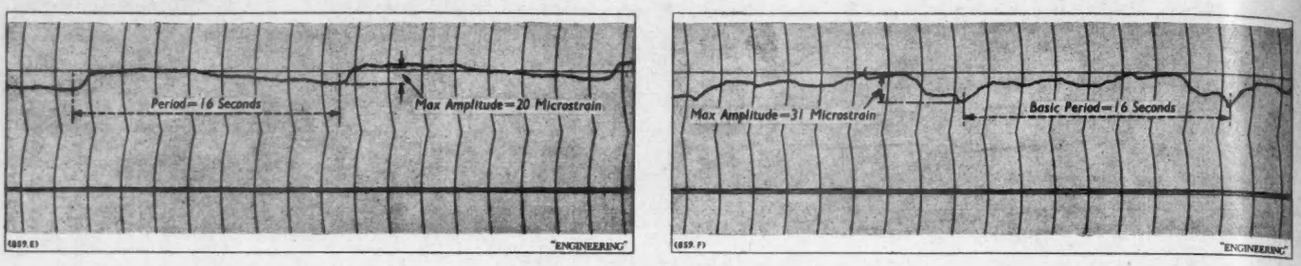


Fig. 5 Typical recordings obtained from links. (Left) Saw tooth form, and (right) a complicated form made up of several harmonics.

this test the gauge factor of the link was evaluated.

Test Results

Results obtained from links bolted to a transmission tower during two separate structural tests were consistent with those obtained from gauges applied conventionally in previous tests; this was in spite of the fact that for one test the links had to operate under water. Fig. 3 illustrates the degree of penetration that was obtained between link and parent material, a closer examination of which revealed that no slipping had occurred.

A second application of the link is illustrated in Fig. 4. Links were clamped to the earth wire cradle of one of the high suspension towers carrying 275 kV conductors across the River Severn between Aust and Beachley. Oscillation frequencies of the cable movement under various wind conditions were recorded over a period of seven months, during which time the link was in an exposed position at the top of the 500 ft high tower. The recordings were made in a test hut at the bottom of the tower via a 500 ft long lead wire. Even at the end of seven months, the rate of zero drift was small (approximately 8 microstrain per hour), while the links remained sensitive to the smallest visible movement of the earth wire.

Conclusions

Fig. 5 shows the recordings made, the frequencies shown comparing well with those recorded at the time with a cine camera. Cyclic forms agree with those which have been determined mathematically for similar wind conditions.

The links have proved to be accurate, sensitive and reliable. They have the added advantage that resistance strain gauges can be applied and waterproofed in the laboratory by skilled personnel, while the links themselves can be readily fitted on site by industrial labour, even under adverse weather conditions. The time taken to fit one link is short and test work may be planned without the necessity to allow for suitable weather conditions beforehand—a factor which cannot be ignored with conventional strain gauging. The overall cost of the link is small since stringent machining limits are unnecessary, and man hours at site are small.

Acknowledgment.—This article is published with the permission of the Director, Central Electricity Research Laboratories.

Construction Progress at Dungeness

Progress on the Dungeness nuclear power station is shown in the accompanying photographs. The most advanced structure is the biological shield for the No. 1 reactor, which is 80 per cent complete. As is shown in the right hand illustration, the structure for No. 2 reactor (foreground) is above ground level and the outline of the shield and the adjacent rooms is now well defined. Between the two reactors, foundations are being laid for the central change and control block.

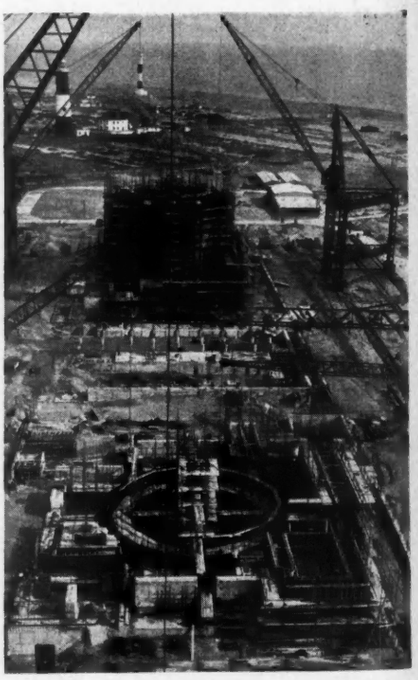
The station, which will have an output of 550 MW, is being built for the Central Electricity Generating Board by The Nuclear Power Group. Construction began on 1 August 1960 and at the end of September about 1,000 people were at work on the site.

The photograph below shows the progress being made on the turbine house. The basement floor and the retaining walls are well advanced and ready for the first structural steelwork to be erected. Work is also in hand on the four main turbo-alternator support blocks. The same photograph also shows, offshore, the marker for the cooling water intake which will be connected to the pump house by a 1,000 yard long tunnel. The pump house itself will be circular in plan and is being built in two halves. The first half has been excavated, the floor raft has been completed and the support wall now nears ground level. Work has also started on the cooling water syphon recovery chamber whence the cooling water is discharged into the sea.

The 400 ton Goliath crane nears completion and will be tested shortly and a smaller Goliath, of 40 ton capacity, is briefly described elsewhere in this issue.

The top crown and the bottom dome for the pressure vessel for No. 1 reactor are complete about 60 per cent and work has begun on the second ring. Of the boilers, four are being site built and four are to be made at Head Wrightson's Thornaby works on the River Tees and floated down the east coast. At the site, work has actually been begun on three of the four boilers; the bottom domes of two are complete and other plates are being welded into position.

The constituent companies in the Nuclear Power Group comprise: Associated Electrical Industries; Clarke, Chapman; Alex Findlay; Head Wrightson; Sir Robert McAlpine and Sons; C. A. Parsons; A. Reyrolle; Strachen and Henshaw; John Thompson; and Whessoe. The Group have their headquarters at Radbroke Hall, Knutsford, Cheshire.



(Right) From the top of the Goliath crane, the construction work in progress on the No. 1 and 2 reactors; foundations of the control room and change block are between the reactors.

(Left) Foundations for the turbine house. Offshore is the head of the cooling water intake structure and at the far end of the turbine house work is progressing on the pump house. From the near end of the turbine house comes the culvert leading to the syphon recovery chamber.

The graph in the Special Article "Economic Planning's New-Found Favour" (ENGNG., 13 Oct. '61, p. 471) contained an inaccuracy in that the indices for "Total in Civil Employment (Thousands)" should have read for each year from 1949 to 1959 respectively as follows: 22,282; 22,539; 22,761; 22,647: 22,771; 23,148; 23,477; 23,697; 23,789; 23,607 and 23,731.

Human Element

Accelerated Output of Scientists and Engineers

This month, HMSO have published (at 1*s* 9*d* per copy) *The Long-Term Demand for Scientific Manpower*, a report from the Statistics Committee of the Advisory Council on Scientific Policy with a covering memorandum from its Committee on Scientific Manpower. It follows an earlier report, made in 1956, and is based on the 1959 survey of degree standard scientists and engineers.

Statistically, the report is somewhat insubstantial, a fact which, together with the time taken to process figures available two years ago, suggests that the Council's administrative backing is very thin and makes the document unfortunately speculative at some important points. For example, definitions of "scientists" "engineers" and "technicians", always difficult and often futile, have been bedevilled by attempted comparisons with the position in the USA where these definitions are different again.

Nevertheless, the report attempts a more detailed forecast of demand over the next decade than has been attempted hitherto, the central point it makes being that Britain now appears likely to achieve as early as 1965 the annual output of 20,000 qualified men and women which the 1956 report said the country would need to achieve by 1970. Indeed, it now seems that Britain will probably have an output of 30,000 a year early in the 1970's. One of the report's insufficiencies, however, is that the Council has not had the resources to analyse the prospective supply in the individual branches of science and engineering (though they are able to foresee continuing failure to meet the demand for mathematicians) so that, for all the Council may know, the country could be heading for a disruptive shortage of some types of scientist and engineer in the midst of a glut of most other types.

Management Overflow

Whatever this distribution between the different sciences and technologies might be, though, there is now the probability that there will be a more than adequate supply overall. The Manpower Committee consider that this prospect is encouraging in that it will enable people educated in scientific disciplines to go into management, administration and the professions on a wider scale. It is obviously important that some managers and some administrators should have had a scientific or technical education. But there is, in this suggestion that scientists and engineers can equally well become something else if there are not enough scientific and engineering jobs, a bland assumption that a manager or an administrator can be drawn from whatever type of educated manpower happens to exist in excess of current demand. The arts graduates of yesterday did not become the top managers and the top administrators simply because there happened to be a lot of them and, by the same token, the scientists and engineers of tomorrow will not become top managers and top administrators simply by force of numbers. They could even become a new repressed and disgruntled class.

Unfair to All

In the same way that the top levels of management and administration need impregnating with scientific and technical understanding, so the individual scientists and engineers will need impregnating with some understanding of the humanities. If more scientists and engineers become managers and administrators, the time has come (indeed, it came several years ago) for much more liberalizing of scientific and technical education.

If more of these courses are not, in fact, liberalized, it will be unfair to those scientists and engineers who go into management and administration, particularly if they would rather have been "pure" scientists or engineers. It will also have been unfair to the taxpayer who will have paid three times as much to educate them as he would have paid to educate an arts graduate.

If the Advisory Council on Scientific Policy is to get to the bottom of the problem which it has now partially revealed, it must surely have the power and the resources to make quickly a scientific estimate of the number of scientists and engineers required to impregnate other fields, and it must include this number in the overall demand for scientific people, not regard it as an amorphous overflow. Further, the Council should give more consideration to whether scientific education really does equip men and women for management and administration. Or perhaps this is someone else's job. It usually is.

The New Concept of Management

A principal speaker at this month's British Institute of Management one-day conference on "Management Succession and Development" was Professor Douglas McGregor, of the Massachusetts Institute of Technology. In his two papers, he warned of the way in which the classic concept of line-and-staff management (together with the related concepts of chain of command and span of control) is rapidly becoming unequal to the strain imposed on it by the accelerating rate of industrial change. This change is social and economic, as much as scientific and technological.

Professor McGregor listed five prime requirements for successful management at the present time, namely (*a*) talented men, not just at the top but in every phase and at every level of the enterprise; (*b*) effective team collaboration, with the emphasis on the group, not the individual, as the essential unit; (*c*) a quality of dynamism, of flexibility, adaptability, innovation and risk taking; (*d*) keeping management committed to organizational goals in the face of increasing managerial specialization; and (*e*) integrity from everyone within the firm. To meet these goals, the professor advocated the development of the comparatively new concept of organic or group personality management at every level.

In this way, many so-called "staff" functions can be brought more closely in touch with "line" executive functions, to common advantage. Professor McGregor quoted the example of a management team, formed on the group concept, which very effectively took over responsibility for its own quality control.

Wasted Talents

The common methods of management, he said, do not utilize all the talents of everyone at all levels and they do not provide fast enough information —particularly in feedback up the management line—to suit the current needs of industry. But, where a group has been organized on the basis of a group task rather than on the basis of narrow individual tasks, the results have usually been improved productivity, reduced waste, lower absenteeism, increased acceptance of responsibility and greater flexibility.

An essential by-product of Professor McGregor's main thesis was the proposition that it is a very false notion that a man only grows in experience and in importance to his firm in relation to his promotion. In fact, a man can grow and improve without his duties and position changing (the professor gave the example of his own work as a university lecturer), and it is too rarely recognized that this horizontal growth is as important as vertical growth up the ladder of promotion.

During the panel discussion at the end of the conference—when Professor McGregor was joined by Dr. A. T. M. Wilson of Unilever, and Mr. J. O. Blair-Cunyngham of the Royal Bank of Scotland, with Mr. Norman Fisher in the chair—it was obvious that the professor's idea of introducing organic management and playing down the classic concepts had made a profound impression on the delegates.

So profound was this impression, indeed, that, at about this time, two top management types were seen despairingly studying *The Times* appointments vacant columns. On the other hand, of course, they might have been searching the appointments vacant column for prospective members of their new-look group personality set-up.

A rather more public demonstration of the interest aroused by this new concept of management is the fact that the British Institute of Management are holding a one-day seminar on it later this month.

Production Engineers' Responsibilities

Under the title, "A Time for Greatness," the new President of the Institution of Production Engineers, Mr. Harold Burke, has sent a personal letter to every member of the institution (nearly 13,000 in all) appealing to them to face up to their personal responsibilities during the present national crisis. He asks them not to take up time apportioning economic or political blame for the present position but to intensify their personal efforts to increase productivity. This appeal is in line with an article Mr. Burke has written in this months' issue of *The Production Engineer*.

Pointing out that economists estimate that a 3 to 4 per cent increase in national productivity (to look on the black side, this sounds astronomical compared with our recent record) would considerably stabilize the economy, he urges production engineers to consider how they might improve on their personal contributions both within and outside their jobs. Within their own work he urges them to regularly examine their production costs and methods and to keep up to date with modern trends by constant study of what other people are doing. Outside their own work, he urges production engineers to consider whether they are exerting enough influence by taking part in Institution activities, giving full support to Local Productivity Associations, and lending their support and experience to local technical colleges, colleges of advanced technology and universities.

The President's final suggestions to members are that they should reflect on whether they are doing all in their power to spread knowledge of production engineering and whether they are "positive and active," instead of "negative and passive." It is intended that the Institution shall pursue this theme at national level throughout 1962.

The Full Life

Engineers are produced in a hotch-potch of ways: at universities, at colleges of advanced technology, at full-time technical college courses and at part-time technical college courses. They go through a multiplicity of apprenticeships which vary in emphasis and content from firm to firm, from industry to industry and from area to area. Making a virtue of necessity, we often say that this is good for industry and widens its outlook. Perhaps we think too little about whether it is good for the invididual trainee engineer and widens his outlook.

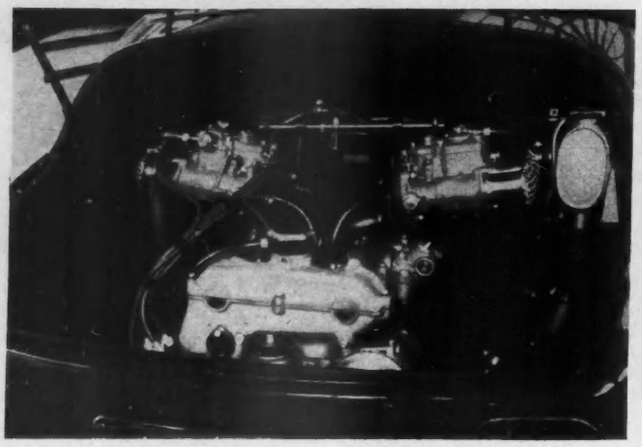
In their film, "Eye to the Future," ICI aim to show school leavers what engineers do and how some of them are trained to be thinking and creative engineers. That ICI succeed in this aim is indicated by the film's success at last year's Industrial Film Festival in Turin where it won an award as the film that "most effectively stressed the technical, economic and social value of correct professional training as a means towards the better employment of human capabilities."

Perhaps the spirit of the film is typified by a scene in which Professor Sir John Baker addresses a group of Cambridge freshmen engineers. He tells them, "Our first aim is to teach you to think for yourselves. You will be faced by unknown and unpredictable conditions. They will call for originality on your part. That makes ours an exciting profession, but it is also a responsible profession."

The film then follows one of the recipients of these words of wisdom through his university career. He is shown at various activities, including working in the lecture theatre and in the library; heaving on the end of an oar in approximate unison with seven other hearties; punting a rugger ball prodigious distances; undertaking practical training in the UK and in Canada; and dancing, in rather charming company, in a cellar club. The professor never said a truer word.

If it does nothing else, the film does an important job in demonstrating that engineers can be as resourceful and as human and as broadly educated as anyone else—in fact, more than most. The film may be borrowed from ICI's film library at Imperial Chemical House, Millbank, London SW1.

XUM



Highly successful in Grand Touring races, including the 500 km at the Nurburgring, Abarth's latest 1000 Bialbero has its radiator at the front, and its two twin-choke Webers perched on pairs of inlet pipes rising out of the cylinder head. It develops nearly 1000 bhp per litre.

Power unit of new S1004 Glas coupé and convertible is a water-cooled four with overhead camshaft driven by a cogged belt of nylon reinforced with fine wires. This engine has a five-bearing crankshaft, dimensions of 72 × 61 mm (992 cc), 8·5 to 1 compression ratio and an output of 42 bhp.

Engine Changes in Britain and Abroad

In this second of three weekly articles, Gordon Wilkins reviews developments in engines, and concludes his report with some details of the new Rover gas-turbine car.

By Gordon Wilkins

ALTHOUGH Volkswagen has successfully made the transition to a 1,500 cc engine in light alloy, other car makers using light alloy engines, whether air or water cooled, have met with disappointing setbacks. The Chevrolet Corvair with its light air-cooled Flat Six has not achieved a very high rate of output and another much admired engine, the small V8 produced by Buick, has apparently proved expensive to manufacture and is now being superseded for 1962 by a cast iron V6. General Motors have been building V6 truck engines for two years, but this is the first such unit for an American car. It is briefly specified as a 90° V6 (92·07 × 81·28 mm) 3,245 cc capacity and develops 135 bhp SAE at 4,600 rpm on a compression ratio of 8·8 to 1. It is said to weigh about 140 lb less than equivalent six-in-line engines.

Another General Motors innovation intended for limited production only is a special version of the Oldsmobile 3½ litre V8 designed for sports cars. It uses an exhaust driven supercharger made by Air Research, and an inward flow turbine also driven by the exhaust operates a centrifugal blower; an alcohol-water mixture is injected, permitting the use of a compression ratio of over 10 to 1. Output of the engine is thereby increased to 215 bhp.

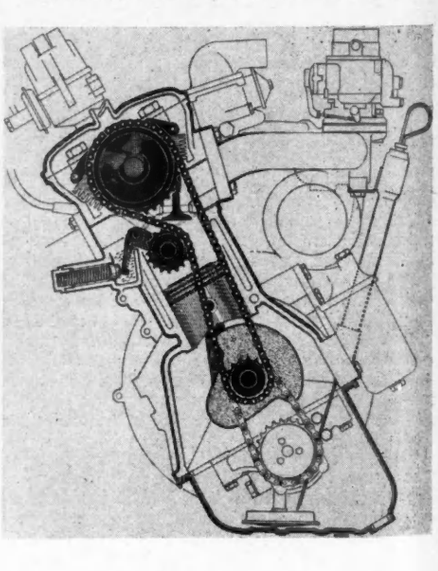
Among the smaller European four-cylinder engines, there is a marked tendency to the adoption of five-bearing crankshafts to permit the use of higher compression ratios and revolution speeds. Following the introduction of such a shaft on the Simca Aronde engines, the rear-mounted four-cylinder engine of the Simca 1000 is similarly equipped. Canted at 15° to the vertical, it has bore and stroke of 68 × 65 mm (944 cc) to give 45 bhp SAE at 5,000 rpm with maximum torque of 54·2 lb-ft at 2,800 rpm, the compression ratio being 7·8 to 1.

FIVE-BEARING ENGINES

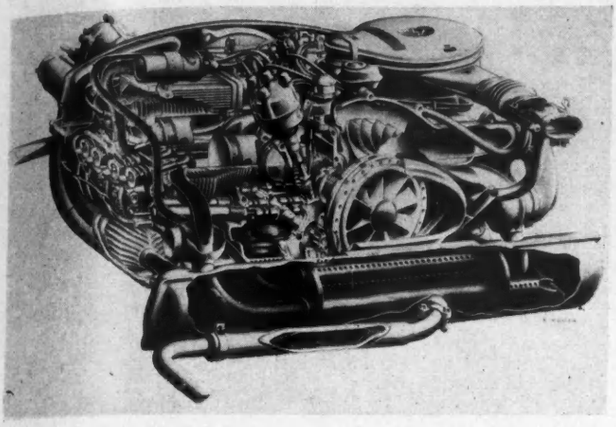
Another small five-bearing engine is the new unit produced for their S 1004 coupé by Glas, makers of the Goggomobil. The outstanding feature of this engine—to be seen in the illustration—is a single overhead camshaft driven by an exposed cogged belt of nylon reinforced with wire, a cheap and quiet form of drive whose behaviour will be watched with interest. With dimensions of 72 × 61 mm (992 cc) the engine produces 42 bhp net at 4,800 rpm on a compression ratio of 8·5 to 1. Yet another new five-bearing engine is the new BMW with a chain driven overhead camshaft. This has the same bore as the largest of the BMW V8 engines with a slightly shorter stroke of 82 × 71 mm (1,499 cc) and develops 75 bhp net at 5,500 rpm, using an 8·2 to 1 compression ratio and a single downdraught carburettor on a water-heated mounting on a manifold with four long branches.

The way was prepared for manufacture of the VW 1500 engine by the introduction of stronger crankshaft and crankcase on the standard unit, but in its production form the larger engine shows important departures from the original design. The cooling fan is mounted on the end of the crankshaft, reducing the height of the unit and eliminating troubles due to broken drive belts. Height is also saved by mounting the oil cooler on its side, permitting the provision of a second shallow luggage space above the engine, which is located in the tail of the car.

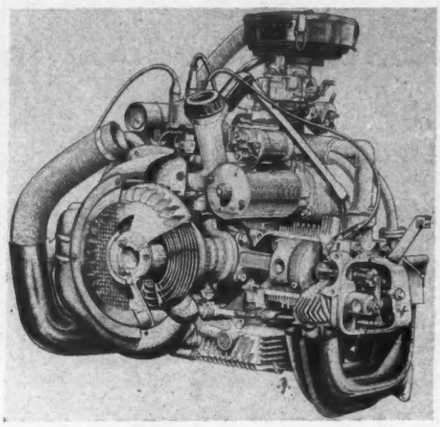
In spite of the extensive use of sand castings and die castings in light alloy by VW, most designers are still reluctant to embark on any extensive use of pressure die castings for engines because of the difficulty of making any subsequent changes that may be required in the course of engine development. However, these considerations do not seem to have inhibited the Russians who have been using light alloys for some time on their 2,445 cc Volga four-cylinder engine and



(Left and right) Inclined four-cylinder engine of BMW 1500, with single chain-driven overhead camshaft. The chain is hydraulically tensioned. The engine has a bore by stroke of 82 × 71 mm to give a capacity of 1,499 cc, and an output of 75 bhp net at 5,500 rpm. It has the new fashionable five-bearing crankshaft, and a water heated inlet manifold.



(*Left*) *The VW 1500 has an air impeller on rear end of crankshaft; delivery guide vanes; horizontal oil cooler at front of engine; and an adjustable warm air intake for the carburettor.*



The redesigned DAF engine with two cylinders of 85·5 × 65 mm (746 cc). With a compression ratio of 7·1 to 1, it develops 30 bhp at 4,000 rpm. It has a double-sided impeller in the ducted cooling system; one side draws air over the circular tubes of the air cooler.

are at present installing equipment to produce the complete cylinder block and crankcase as a pressure die casting.

Useful progress on a more modest scale is to be seen in the improved power unit installed in the latest Vauxhall Victor, which uses light alloy for the thermostat, water pump and oil pump housings, inlet manifold, bell housing and gearbox extension shafts housing.

Improvements in filtration techniques have helped to make possible an extension of oil change intervals to 3,000 miles on many British engines, but the American manufacturers have simultaneously extended their oil change periods to anything from 4,000 to 6,000 miles. Several American manufacturers have also adopted improved anti-freeze mixtures with inhibitors which allow them to be kept in the radiator safely for periods up to two years.

The most interesting development in water cooling in Europe is the sealed cooling system of the Renault R4 utility car. As the temperature rises, the expanding coolant rises into an expansion tank where it displaces air which is expelled through a valve. As the fluid contracts on cooling, air re-enters the tank to replace it. Ordinary rubber hoses are used, which place a limitation on the total life of the system, but it may reasonably be expected to last between engine overhauls without attention.

Rationalization proceeds steadily among British engines for popular cars. The Rootes Group have now standardized a 1·6 litre engine with only relatively minor variations over the whole range of four-cylinder cars, apart from the Hillman Husky. All BMC cars using the B-type engine now have the improved versions with bigger bores giving a capacity of 1,622 cc and the MG type cylinder head with larger valves.

The compression ratio is unchanged at 8·3 to 1, but the use of stouter connecting rods, solid skirt pistons and thicker crank webs has permitted an increase in net power on the single carburettor engines from 52 bhp at 4,350 rpm to 61 at 4,500 and maximum torque rises to 90 lb-ft at 2,100 rpm. The bearing width has been reduced, but safety margins have been maintained by the use of lead indium bearings. These extensive alterations to the single carburettor engine have reduced the margin of superiority offered by the twin carburettor units in the MG Magnette and Riley 4/72.

TWIN CARBURETTORS

An interesting point emerges from a study of the dimensions of the new twin carburettor engine used in the Cooper version of the BMC Minicars. The standard model with bore and stroke of 62·9 by 68·26 mm (848 cc) is basically a short stroke version of the Morris Minor 1000 unit (62·9 × 76·2 mm, 948 cc) which is also used in the Austin Healey Sprite and MG Midget. The engine in the Cooper version has a smaller bore but a much larger stroke (62·4 × 81·3 mm, 997 cc). With different crankshaft cylinder head and other parts, this is virtually a new engine and may presumably be the starting point for something of larger capacity when the times comes to replace the Minor.

The continued use of twin carburettors on siamesed inlet passages is a surprising feature of some British designs, particularly in view of the known difficulty of maintaining accurate synchronization between two carburettors relatively far apart. On the other hand, continental manufacturers of small sports type engines make greater use of twin choke carburettors. In some cases their carburettors have been mounted transversely so that one choke supplies cylinders one and four and the other one cylinders two and three.

An advance design, developing nearly 100 bhp per litre, is the Abarth 1000 Bialbero, which uses two horizontal twin choke Weber carburettors hung on four curved pipes rising above the cylinder head. The whole assembly looks rather vulnerable but it has successfully won over some difficult long distances.

The problem of synchronizing multiple carburettors and that of ensuring smooth throttle operation may be within sight of solution by the use of a new pneumatic throttle control developed by Dunlop. In this equipment a piston operated by the accelerator pedal displaces air through a plastic tube to operate a rolling diaphragm which moves the throttle spindle.

ROVER'S GAS-TURBINE

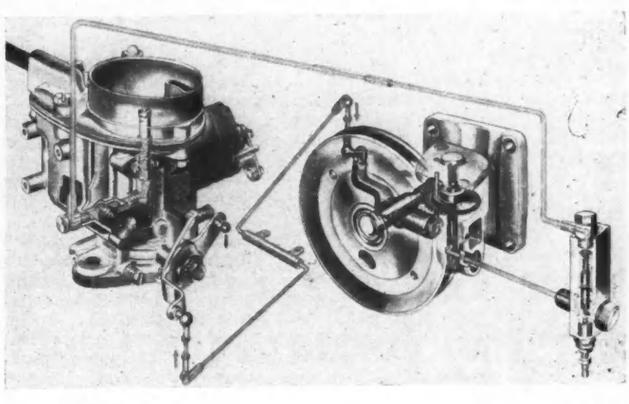
Rover have just released photographs and brief details of their latest experimental gas-turbine car, the T4. It incorporates all the lessons learned in ten years of gas-turbine research since the construction of the company's first 250 bhp car, Jet I, which reached a speed of 150 mph in 1952. The new car is a comfortable four-seater four-door saloon of attractive modern lines. The whole power unit, consisting of compressor turbines, heat exchangers and their auxiliaries, is housed in the front of the car and drives the front wheels. The car has independent suspension to all wheels developed from the type used on the previous Rover turbine car, the four-wheel drive T3. The power output is 140 bhp.

The air intakes necessary to handle the large volume of air required by a gas-turbine are very neatly arranged round the four headlamps and the air filters are housed inside the front wings. Rover have been experimenting with various turbine designs and they produced a very efficient lightweight gas-turbine auxiliary power unit which is used in some of the latest and fastest bombers of the RAF.

To secure a quick response when the throttle is opened suddenly, they have been working on a system of adjustable guide vanes controlling the flow to the compressor turbine. The vanes are linked to the accelerator and enable the compressor to be speeded up to full output in a very short time; during idling periods, fuel consumption is reduced and the pressure and temperature drops across the heat exchanger are minimized. One system which has been developed makes use of an inward flow compressor turbine, working in the reverse way to a centrifugal compressor, followed by an axial flow free turbine driving the car.

Some success has been achieved with cast turbine wheels and guide vanes which have proved capable of standing speeds far higher than the maximum of about 65,000 rpm normally used. The method of controlling output by throttling the inlet to the first turbine has been rejected by some designers in the United States as being likely to cause compressor surge, but Rover say that they are happy with the results of their own development work.

The new model incorporates all the latest lessons of Rover's research and its performance will enable a decision to be taken on whether the gas-turbine is now ready to power cars sold to the public.



Components of the DKW and Auto Union automatic lubrication system. Oil supply is governed by the speed of the engine, which drives the Bosch pump, but the stroke of the piston in the oil pump is varied by the throttle linkage acting on a cam in the pump. Oil delivery is therefore proportional to the throttle opening. At low speed, closed throttle, the oil to petrol ratio may be as low as 1:100.

XUM

Rootes Introduce the Super Minx

A new 1·6-litre saloon, the Super Minx is the culmination of more than 30 years of progressive family car development by the Rootes Group. It has a completely new body design, a smooth 80 mph plus performance, and includes such advanced features as anchorages for three types of safety belt, complete undersealing and only three greasing points.

The Hillman Super Minx is an addition to the current range of Minx models which, at their recently reduced prices, continue for 1962. Although only 3 in longer and 1½ in wider than the Minx, the new car offers a considerably more spacious interior and more engine power. It has a clear-cut styling, and its low lines are softened by contoured side and roof panels. Curved wrap-round front and rear screens and deep, wide side windows emphasize the modern look and give the driver instant vision from every angle. It has been possible to mount the rear seating well within the longer wheelbase, the length of which also allows wide rear doors and a full width seat with comfortable accommodation for three people.

Powered by the well proved 1,592 cc Rootes ohv engine, the performance of the Super Minx is distinguished by a maximum speed of over 80 mph, and a quick, powerful response to the accelerator under all conditions. A maximum power output of 66·25 bhp (at 4,800 rpm) and a high maximum torque of 84·4 lb-ft (at 2,800 rpm) enable the Super Minx engine to maintain its lively performance smoothly, quietly and tenaciously. The strong flexible suspension system employs coil springs at the front and semi-elliptic rear springs.

The standard equipment includes a complete ventilating system built in on new principles to keep fresh, clean air circulating. Child-proof catches are fitted, and these can be set to immobilize the interior handles of all four doors, and there are welded-in anchorages for three types of safety belt—the lap strap, the diagonal, or the latest combined lap strap and diagonal with three-point attachment.

Newly-shaped pendant clutch and brake pedals are included, and an organ-type accelerator pedal, a sports-type centre floor gear shift, and a hand-brake mounted neatly and unobtrusively beside the driving seat.

An 11-gallon petrol tank gives the Super Minx a range of over 300 miles without refuelling. A wide range of optional extras and accessories is headed by the fully automatic transmission system which has proved its efficiency and reliability in service on the Minx models and has now been adapted to make full use of the new car's smooth flow of power. The basic total price is £854 7*s* 3*d*.

The New 4-Litre Lagonda Rapide

The David Brown Group have brought the Lagonda back into the quality car market with an entirely new car, the Lagonda Rapide. It has roomy four-door bodywork styled by Carrozzeria Touring, a four litre engine developed from that of the Aston Martin, automatic transmission, a de Dion rear axle and servo assisted disc brakes. The wheelbase is 1 ft 4 in longer than that of the Aston Martin and the rear track is 2 in wider. The five-seater body is constructed on Superleggera principles, with aluminium alloy panels on a tubular steel framework welded to a steel platform chassis.

The front seats have adjustable reclining backrests, and the rear seat has a centre arm rest and head cushions in the rear quarters. There are arm rests on all doors, pile carpets throughout and picnic tables in the rear. Equipment includes radio with electrically extended aerial, electrically-operated windows and doors, courtesy lamps and reading lamps in the rear, map reading lamp under the glove box, cigarette lighters and ashtrays front and rear. The comprehensive heater, demister and fresh air ventilation system includes a separate rear heater and rear window demister. Doors, glovebox and luggage trunk are fitted with Yale locks. The luggage trunk has a depth of 50 in, the spare wheel being carried in a separate waterproofed compartment, under the floor.

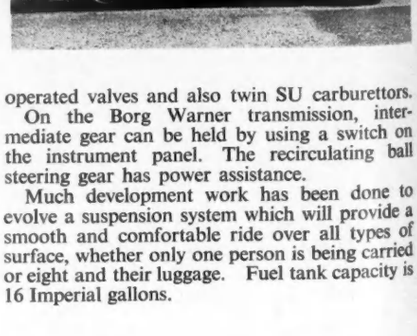
Electrical equipment includes two-speed windscreen wipers and an electric windscreen washer operated by the same control knob.

Power is supplied by a six-cylinder twin overhead camshaft engine developed from that of the Aston Martin DB4 but with bores increased by 4 mm to give a swept volume of 3,995 cc (96 × 92 mm). With two Solex twin choke carburettors and a compression ratio of 8·25 to 1 the engine output is 236 bhp at 5,000 rpm with peak torque of 265 lb-ft at 4,000 rpm.

Camshafts are driven by two-stage Duplex roller chains with manually adjusted tensioner. The Borg Warner automatic transmission has a fluid torque converter and three-speed planetary gearbox. A control on the steering column allows intermediate gear to be held for engine braking. Rear axle ratio is 3·77 to 1. Front suspension is by wishbones and coil springs with ball joint king pins and telescopic shock absorbers. The de Dion axle tube is carried on parallel trailing links and located laterally by a Watt linkage.

Extra space for luggage is created by mounting twin fuel tanks in the rear wings with a balance pipe for easy fuelling, total capacity being 16½ Imperial gallons.

Daimler Limousine has Longer Base



The new Daimler Limousine has been designed to accommodate eight persons in the same degree of comfort as that associated with the current Daimler saloons, but interior space has not been achieved by sacrificing the luggage accommodation for the trunk has a capacity of over 20 cu. ft. The car is equally suitable for long distance touring, daily business use or ceremonial occasions.

This model has the 4·2 litre 220 bhp V8 engine, Borg Warner automatic transmission, servo assisted disc brakes and power-assisted steering. It has a wheelbase longer by 2 ft, a bigger luggage trunk and much better lines than on the previous model.

The rear doors, the apertures of which are fitted with a step, are particularly wide and open through a full 90°. The steps are concealed by the doors when closed. The main rear seat is upholstered in high quality cloth with foam rubber over a spring base. Wide arm rests are fitted at each side and there is a folding arm rest in the centre. Figured walnut is used for the window surrounds. On each side of the rear seat are a cigar lighter and ashtray, and above the rear quarter windows are flexible assist-grips and interior lights with dual filament bulbs for general lighting or reading.

The two occasional seats fold flat into the floor and the compartment division, and provide a good standard of comfort when in use. Maximum leg room has been obtained by the use of foot wells in the floor, and by inclining the lower part of the division between front and rear compartments. The fixed division itself incorporates large sliding glasses, a centrally positioned ashtray and grab handles for use when entering or leaving the car.

The front compartment has a bench type seat trimmed in leather. Both front doors carry arm rests and pockets with hinged covers. A map-reading lamp is operated by a switch mounted on the instrument panel as well as by the front doors. Separate heater-ventilation systems are employed for front and rear compartments. The fresh air heater for the front incorporates a defrosting and demisting system for the windscreen and is controlled from the facia panel. In the rear, warm air outlets are located at floor level.

The power unit is the Daimler V8 of 4,561 cc with compression ratio of 8 to 1, pushrod operated valves and also twin SU carburettors.

On the Borg Warner transmission, intermediate gear can be held by using a switch on the instrument panel. The recirculating ball steering gear has power assistance.

Much development work has been done to evolve a suspension system which will provide a smooth and comfortable ride over all types of surface, whether only one person is being carried or eight and their luggage. Fuel tank capacity is 16 Imperial gallons.

Sealed-Charge Batteries and Battery Chargers

Two new ranges of car batteries, in which the plates have been charged and sealed at the factory, are being introduced by Associated Electrical Industries Limited (Stand 267) at the International Motor Show, Earls Court, London, 18-28 October. They will be seen alongside battery chargers of types ranging from 3 to 25 amperes.

These AEI products will also be shown at the Scottish Motor Exhibition, to be held in the Kelvin Hall, Glasgow, 10-18 November, and are being exhibited by the Accumulator Department of AEI Electronic Components Division.

Transported and stored in the dry condition, the new batteries are ready for use shortly after the addition of acid. Within half an hour of purchasing, a customer can have installed in his car a battery which he knows is brand new and working at its full capacity. Indefinite shelf life is claimed for the new ranges of batteries, and on account of the effectiveness of the drying-out and sealing processes employed at the factory after the plates have been formed, the batteries are said to be unaffected by humidity. The sealed-charge principle means that banks of batteries no longer have to be kept in fully charged condition by the distributor, who is also relieved of the task of constantly checking the condition of batteries in stock. These new batteries are being produced as standard and heavy duty units in both 6 and 12 volt sizes.

Among the chargers to be exhibited is the 3 ampere battery charger, a lightweight (7½ lb) unit which fits unobtrusively into any corner to provide readily for 6 and 12 volt batteries. The 5 ampere charger, weighing 13½ lb, can deliver a full charge to a 6 or 12 volt battery; the 30 volt 10 ampere metal charger can cater for four 6 volt series-connected batteries. The 75 volt 10 ampere charger handles 20 6 volt batteries at 6 amperes or five 12 volt at 12 amperes, and the 6/12 volt 25 ampere boost charger is designed to give quick charging facilities in the simplest possible form and at the lowest price consistent with reliable service.

An Anti-Theft Master Switch

Joseph Lucas Limited, as a result of their efforts to provide a practical and economic solution to the problem of car thefts, have evolved a method of guarding a vehicle that is capable of considerable variation and may also make use of a number of items already fitted as standard equipment. This is claimed as a basic answer to the car theft problem—a method that will not provide the thief with a set system of warning to make ineffective, but one that will face him with a different system for every car.

A Lucas model S45 Anti-Theft master switch may be placed almost anywhere inside or outside the car and is key operated to make the system "live." To provide further safeguard, the lock itself does not carry a reference number which would allow the thief to match it quickly with a certain type of key. The keys only are numbered. Thus, apart from the thief having to locate the S45 switch he will always have two locks to "break" (the S45 switch and the ignition switch) before he can actually steal the car.

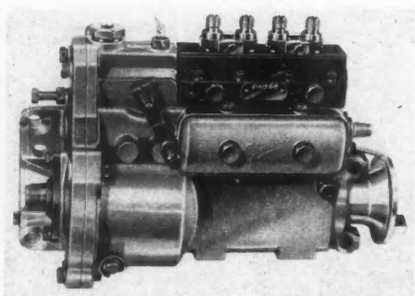
Doctors and other professional men carrying valuable or dangerous property may be particularly interested in the first system described, which guards against theft from a vehicle as well as theft of a vehicle. This requires the S45 master switch to be placed anywhere outside the vehicle and is "set" by the owner after he has closed all the doors. Linked to the master switch are a number of small switches placed so that they will be operated should a door, boot lid or bonnet be opened. These switches are so connected together that should a thief try to enter the vehicle or open any part of it while the system is "live," the horn will be sounded continuously. The S45 master switch costs 17*s* 3*d*, and small door pillar switches model 54SA are available at 1*s* 9*d* each (a more robust version, model 94, for heavy duty requirements, is also available, price 7*s*).

If the owner wishes only to guard against his vehicle being stolen, then he has the choice of fitting the master switch inconspicuously either inside or outside the car. With this method, of course, door switches will not be required, the S45 master switch being wired into the electrical circuit as the owner wishes. The more obvious suggestions for wiring are either as a circuit breaker in addition to the normal ignition switch, or connected so that the horn sounds if the ignition is switched on.

Fuel Injection Systems

The central feature on the stand of Simms Motor Units Limited (No. 203 in the Gallery at this year's Earls Court Motor Show) is an actual working model of the new Mark II development of the Simms Petrol Injection System.

The basic principle of this system was demonstrated for the first time at last year's Motor Show, but the new Mark II model which is now being displayed in operation is the result of twelve months' exhaustive testing on a variety of engines of British, Continental and American origin which has finally proved the system's fundamental soundness and resulted in further improvements in fuel economy and performance.



The Simms 4-cylinder Minimec fuel injection pump.

On a typical 4 cylinder engine of 845 cc capacity a full load consumption of 0·44 lb per bhp per hour has now been achieved, which represents an improvement of from 8 to 12 per cent over results obtained twelve months ago. The advantages of petrol injection, well demonstrated by the Mark II Simms system, may be summarized as being greater volumetric efficiency, increased power and improved acceleration together with fuel economy.

Also well to the fore on Stand 203 is the Simms Minimec fuel injection pump. Especially suitable for use in hire cars and station wagons, the Minimec is said to be the smallest in-line pump of its kind in the world; it has a built-in mechanical type governor. Three, four and six cylinder models are available.

An Improved Range of Car Radios

A new range of car radio receivers by Ekco Radio and Television Limited is being shown on Stand 66 at Earls Court. These improved models feature simpler installation and operation, better appearance and decreased battery consumption.

A choice of two basic receiver models is provided, over fifty specially styled installation kits allowing rapid fitting of either model in almost any car with a 12 volt electrical system.

The lower-priced basic receiver, Model CR915, consists of a single unit which can be fitted through a standard 7in by 2 in aperture from either front or rear, the case having no projections. Manual tuning on medium and long waves is simplified by an easy-to-read dazzle-free, edge-lit scale. The receiver employs three valves and two transistors, giving good reproduction with an output of approximately 2 watts. Advanced circuit design is claimed to ensure a first-class performance with a very low battery drain of a little over one ampere.

The de-luxe receiver, Model CR917, consists of a main receiver unit of similar size to the CR915 with an additional output unit which can be mounted independently. Push-button selection of up to five stations is available as well as manual tuning, while pre-set stations can be changed whilst driving. The circuit incorporates three valves and three transistors with a push-pull output stage giving over five watts output.

Both receivers employ printed circuits for extra reliability. A tuned RF stage gives good long-range reception and high-quality speakers are provided to ensure satisfactory reproduction.

Model CR915 costs 21 gns. and Model CR917 29 gns., both prices including speakers and installation kits but not the small PT surcharge.

Diesel Engine Starter for Low Temperatures

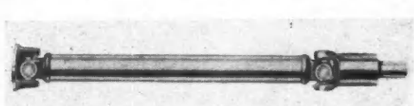
CAV Limited are showing the type "357" Thermostart on Stand 208 at Earls Court. This device is designed to assist the starting of diesel engines at low ambient temperatures, which it does by heating the inlet air by burning fuel in the induction manifold.

The Thermostart comprises a tubular valve body carried in a holder which screws into the inlet manifold, and is surrounded by a heater coil, an extension of which forms an igniter coil. The valve body carries a central rod or needle, the end of which holds a ball valve in position against its seating. The whole is surrounded by an open perforated shield. Fuel is admitted to the heater through the ball valve, normally held on its seat by the end of the central rod. On switching on, current passes through the coil and heats the tube, which expands. The rod is thus moved sufficiently to allow the ball valve to lift and admit fuel; this flows along the heated tube and is vaporized. Air is drawn into the manifold when the starter motor is engaged and mixes with the vapour; the mixture is ignited by the open coils which are at ignition temperature.

On the Thermostart switch being released, the tube is rapidly cooled by the flow of air and the central rod returns the ball valve to its seating, cutting off the fuel. The Thermostart is inserted horizontally into the engine induction manifold and is secured in a tapped hole. Fuel is supplied from a small gravity tank, kept replenished from the main system.

Reversed Sleeve Propeller Shaft

Hardy Spicer Limited, a Birfield Group company, are exhibiting on Stand 359 at the Earls Court Motor Show their traditional needle roller universal joints and propeller shafts, which include the reversed sleeve type of assembly with fixed or permanent joints at each end. In this design, the sliding movement is provided for by a longer reverse sleeve yoke fitted to the shaft, which means that this sleeve slides on the splined shaft end in the gearbox extension.



A Hardy Spicer reversed sleeve propeller shaft.

The standard type of assembly, in which provision for sliding movement is made by the inclusion of a slip or sliding joint in the shaft assembly, is also being shown, and for designers and manufacturers of longer wheelbase vehicles, a complete drive line assembly is available.

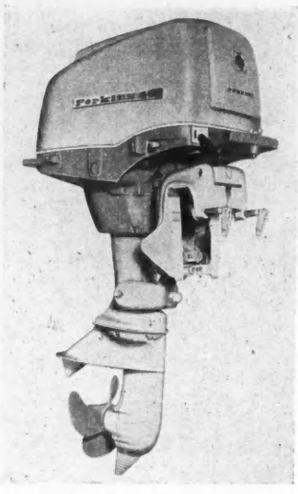
OUTBOARD MOTORS

Silent Operation

CLAIMED to be suitable for many types of craft, a new range of outboard motors is available in sizes of 4·5, 6·5, 18, 30, and 40 hp.

Simplicity of design, silence in operation, and advanced technical features are claimed to distinguish these motors which are water cooled, use petrol-oil fuel, and are available in short or long shaft form. Different propellers can be supplied. Simple tilt systems enable the motors to be easily adjusted to the most suitable angle. The model illustrated develops 40 hp at 4,500 rpm. The two cylinders have a bore of 3⅛ in and a stroke of 2⅞ in. Piston displacement is 44·12 cu. in (722 cc). The carburettor is a Tillotson concentric bowl, with idle adjustment and fixed high-speed jet. Ignition is by a flywheel magneto, which on models fitted with electric starting incorporates a battery-charging generator. The reduction-gear ratio is 21:13.

The propeller is 10 in by 13 in and has right hand rotation. With manual starting, the motor weighs 130 lb and



with electric 137 lb. *Perkins Outboard Motors Limited, Peterscourt, Peterborough, Northants.*

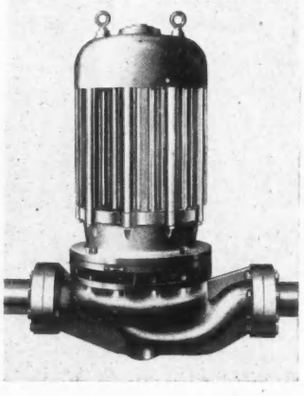
IN-LINE PROCESS PUMP

Easily Accessible

THE WP-N single-stage single-entry in-line centrifugal vertical pump has been designed especially for the chemical and process industries.

No concrete foundation or baseplate is required. The close-coupled arrangement reduces the number of components and is claimed to allow easy dismantling and re-assembly, due to the absence of pump shaft, coupling, pump bearings, and bearing brackets, together with their need for alignment. By taking out a few bolts, the complete rotating element and motor can be lifted clear of the pump casing without disturbing the pipework. The mechanical seal is claimed to give long leak-proof service, removing the need for adjustment and repacking. The elimination of radial and axial thrusts is said to ensure minimum vibration and long bearing life. The materials normally used in the construction of the pump are cast steel and 18/8/3 stainless steel, but other materials can be supplied to meet requirements.

One pump casing and four impellers



with diffusers are said to be able to cover a wide range of duties. The capacity is 450 gallons per minute (or 123 cu. m per hour) against a head of 550 ft. The pump will handle liquids up to 300° F. The maximum working pressure is 300 lb per sq. in. *Sigmund Pumps Limited, Team Valley, Gateshead 11, Co. Durham.*

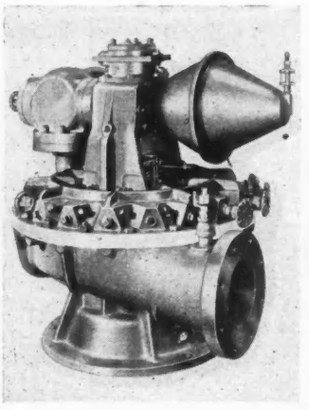
STEAM TURBINES

Available in Six Casing Sizes

NOW marketed in Britain, Coppus vertical and horizontal steam turbines are available in six casing sizes which develop from 1 to 250 hp. The range of output speeds is further extended by built-in helical-gear reduction units.

The design is claimed to be a robust one allowing the utmost operational flexibility. Multiple-nozzle control valves are said to provide better steam economy on continuous part loads. The turbines comprise a two-row Curtis wheel of high-tensile bronze with integrally-cast stainless-steel blading. Roller bearings at both ends support the shaft. Carbon rings are fitted in the sealing glands, which are split to allow the rings to be easily replaced. An excess-speed safety trip, mounted on the shaft end, is normally adjusted to shut the turbine down at a speed about 15 per cent above the normal operating speed.

It is said that the wide range of materials available for the turbines and ancillary equipment, suit them for operation on steam, gas, or compressed



air. Wheel diameters vary from 9 to 22 in; rated capacities with standard wheels being from 7·5 to 161 bhp at 3,500 rpm and 150 lb per sq. in inlet and 10 lb per sq. in back pressure. Rotation is either clockwise or counter-clockwise. *George Meller Limited, 24 Fitzjohn's Avenue, London NW3.*

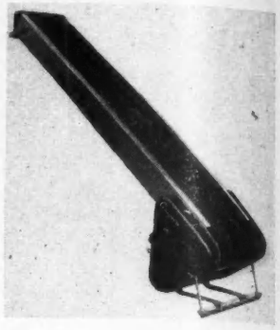
PORTABLE CONVEYOR

Lightweight

THIS general purpose conveyor, known as the Conveyorette, is intended for such work as lorry loading, stacking, and horizontal conveying.

Light in weight, it is claimed to be robust in construction, and to combine compactness with simplicity in design, simple operation, and minimum maintenance. Two boom lengths are available, 9 ft and 12 ft with maximum delivery heights of 6 ft and 8 ft 6 in respectively. In each case the recommended maximum distributed load is 1 cwt. Net weights are 2¼ cwt for the shorter model and 2¾ cwt for the larger. The main boom is constructed from 14 swg aluminium; in operation it is lightly supported at the outer end. The 3-ply belt is 14 in wide and has a grip face; a tensioner is provided. Belt speed is dependent on load but is approximately 60 ft per minute. A simple rotary switch controls starting, stopping, and the direction of running.

Power is supplied by a fully-enclosed ¾ hp 3-phase motor, operating on a



400-450 V 50 c/s supply but if necessary motors can be fitted to operate on other voltages and frequencies. The use of self-lubricating bearings enables the points requiring lubrication to be restricted to the gearbox and road wheels. The latter, 5 in in diameter, are rubber-tyred and retractable. A quick-locking device gives stability when the conveyor is in use. *Gardiner's Conveyors Limited, 10 Lafone Street, Bermondsey, London SE1.*

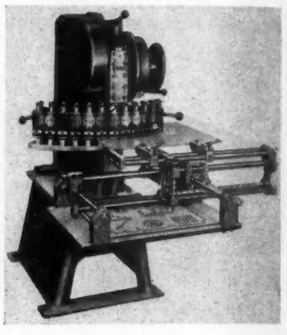
PUNCHING PRESS

Multiple Turret

MODELS SM4/500/12 and SM15/500/18 in the Edel range of multiple-turret punching presses have been developed to enable sheets to be punched with accuracy. Processes where it is suggested that the presses can be employed include the manufacture of radio and transmitter chassis and switchboards.

The SM4/500/12, with a throat depth of 19¾ in, exerts a pressure of 4 tons. It is equipped with 12 tools in the turret head to punch holes up to 1⅛ in diameter in 16 swg, or up to ½ in diameter in 12 swg sheet. The SM15/500/18, which has a similar throat depth, carries 18 tools in the turret head. With a punching pressure of 15 tons, it is able to punch holes up to 3½ in diameter in 16 swg sheet. When using a template, a hole is engaged by a selector pin which makes electrical contact and actuates the magnetically-operated clutch; this sets the punch in motion. For a one-off job the table is set by means of graduated scales.

Drawings can be used as templates with the aid of a pointer, in such cases



the electrical contact is hand operated. A safety device prevents unintentional duplication of punching. Setting and punching one hole to exact measurements is reported to occupy from 12 to 21 sec. Punching by means of a template takes from 1 to 2 sec per hole, according to the size of the machine. Resetting the turret head to suit a different type of tool is said to occupy from 3 to 6 sec. *F. J. Edwards Limited, 359 Euston Road, London NW1.*

ADJUSTABLE VENTURIS

For Fuel Units

THESE venturi throat valves, which have been developed for use in refuelling units and fuel dispensers, are stated to provide an efficient method of measuring hose-end pressures.

A feature of the design is the integral by-pass channel which provides an alternative fluid path to that of the venturi throat. The flow and pressure through the venturi can be adjusted by closing or partially closing this channel. This feature permits a venturi with a throat of one size to be used for hoses of different lengths and diameters, and of different pressure loss characteristics. Proportioning of the venturi throat is so arranged that the pressure there is always equal to that at the delivery hose end coupling, irrespective of the rate of flow.

The example illustrated is provided with micrometric adjustment, which is claimed to give more sensitive and accurate regulation of the by-pass channel opening. In this model the by-pass opening is regulated by a triangular valve which is said to provide

more sensitive adjustment than is possible with a round valve. Adjustment of the valve is effected by a worm and wheel mechanism.

Suitable for 3 in and 4 in pipes, both the adjustable and micrometrically-adjustable venturis have capacities of 300 and 600 gal per minute in the respective sizes. Location is in the delivery line immediately upstream of the hose reel. Sense lines may be taken from the venturi throat to operate the sense chamber of a pressure control valve. Weights range from 16 lb in the case of a 3 in venturi to 25 lb in the case of a 4 in model. *Zwicky Limited, Buckingham Avenue, Slough, Bucks.*

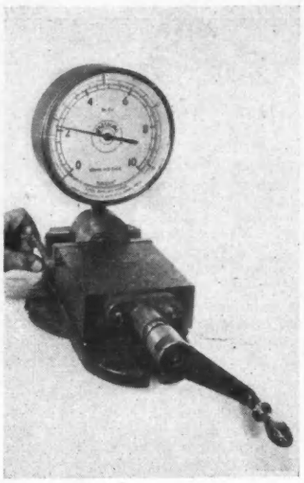
MACHINE VICE

Hydraulically Tightened

THE Abwood hydraulically-tightened machine vice is claimed to embody the advantages of a hydraulic system without requiring the layout usually associated therewith.

This vice, which has jaws with a width of 6 in and gives an opening of 5 in, incorporates two hydraulic cylinders in the moving jaw. These cylinders are connected at their inner ends by a passage, which opens out to form a cylinder, in which pressure is generated by the actuating screw. In use the vice is tightened in the usual manner without using great force, after this initial tightening further pressure is exerted hydraulically by turning the actuating screw by the ratchet provided.

The ratio of the total area of the jaw cylinders to that of the operating cylinder is about 16 : 1, resulting in a high jaw pressure with little manual effort. The illustration shows a pressure of over two tons per square inch being exerted; while this is a higher pressure than is required for most operations it



is, if required, attainable without undue effort. The vice is available with a swivelling base. *Euco Tools Limited, 44 London Road, Kingston, Surrey.*

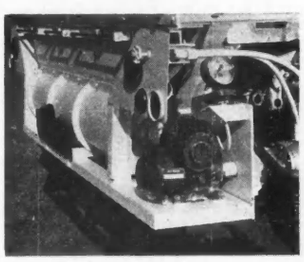
COAL DISCHARGER

Pneumatic Handling

INTENDED to convey anthracite and small coal in bulk and discharge it by a hose to stores above or at a distance, the Pneumarotor is a vehicle with a rectangular aluminium-alloy body on a tipping chassis.

Primarily intended for bulk discharge to industrial users, it is considered that the vehicle's ability to deliver solid fuels quickly and cheaply will also appeal to other users. Discharge is effected by connecting a flexible hose to the rear of the vehicle. The coal falls into a hopper under the vehicle floor, and thence passes to a rotary feeder valve, whence it is blown through the hose to the storage point. The compressed air is supplied by a Godfrey L675 Mark IXB blower driven through a 30 : 1 reduction gearbox connected to a power take-off on the vehicle gearbox. Needle-valve control gives compressor speeds of 20 to 27 rpm. As discharge progresses the body is tipped to feed the fuel into the hopper.

Rates of discharge are dependent upon



the type of coal and the distance over which it has to be delivered. An average rate is 10 tons per hour transported to a distance of up to 50 ft. If required partitions may be provided to enable three separate loads to be conveyed at a time. Should it be necessary the vehicle can discharge by conventional end tipping.

A recently constructed example has a capacity of 13 cu. yd but the size of the body and the make of chassis may be varied to suit requirements. Projected capacities range from 6 to 15 tons. The illustration shows the equipment fitted to a Commer 7 ton vehicle. *Bonallack and Sons Limited, Basildon, Essex.*

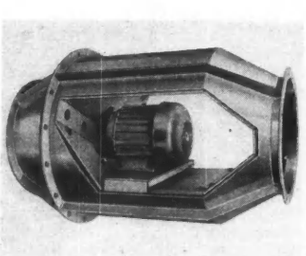
COMPOUND-FLOW FAN

Quiet Operation

COMPOUND flow is employed in the Ax-cent fan, which is claimed to combine the advantages of the basic axial and centrifugal types.

This fan is said to provide approximately twice the pressure development of a single-stage axial fan running at the same speed, and to have volumetric and pressure outputs which are more comparable with a two-stage axial fan. It is claimed that the low sound level and high mechanical efficiency compare favourably with those of a centrifugal fan of equal duty.

A departure from the conventional axial design is the provision of a bifurcated duct. This, as will be seen from the illustration, provides a built-in compartment which protects the motor from air or gases passing through the duct. The fan has a venturi inlet to the shrouded compound-flow impeller, which is fabricated from continuously-welded sheet steel with the blades and inclined shroud and backplate attached to a cast-iron centre boss.



There are 15 sizes available, ranging from 9 in to 30 in diameter. Volumetric capacity extends from 100 to 14,000 cu. ft per minute and up to 14 in wg static pressures can be developed. The maximum temperature is 650° F. The motors are of the totally-enclosed, fan-cooled squirrel-cage type. They are wound with Class B insulation suitable for continuous operation in an ambient temperature of 120° F. Grease-lubricated bearings enable the fan to be mounted at any angle. Motors are wound for direct-on or star-delta starting as required for three-phase 50 c/s supplies. *Keith Blackman Limited, Mill Mead Road, London N17.*

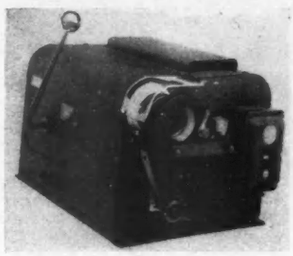
TUBE-END FLARING MACHINE

Simple Operation

THE American-made Tubemaster tube flaring, beading, squaring, and deburring machine is now available in Britain.

It is claimed that this machine will perform the operations referred to with accuracy and speed, even when unskilled labour is employed. A range of machines is available, covering tube diameters of from $\frac{1}{4}$ in to 8 in; stock sizes deal with diameters up to 3 in, the larger machines are made to order. Models include those capable of performing double flaring; both semi-automatic and automatic machines are included in the standard range. Hand, pneumatic, or electric operation is available; in the last-mentioned case the supply required is 220/440 V three phase 60 c/s. Clamping is by means of a pneumatic cylinder. As the machine is operated by a single lever the operator's right hand is free to feed tubing into the machine.

The 2CP model, with a capacity of from $\frac{1}{4}$ to 2 in ferrous and non-ferrous material, has a two-speed spindle to



provide a slower speed for the larger diameter ferrous tubing.

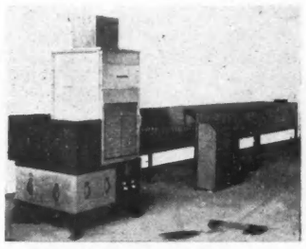
Tools for squaring and burring, flaring, and beading are available for all sizes of tubing. Those available from stock comply to MS/AN/JIC and SAE specifications but special tooling can, in many instances, be supplied to requirements. It is claimed that these machines are particularly suited to the requirements of firms engaged in precision-tube processing, in addition to meeting the requirements of manufacturers of vehicles, air-conditioning and refrigerating equipment, and hydraulic feed pipes. *Pressbend Limited, 28 Marshalsea Road, London SE1.*

SPRAYING AND STOVING MACHINE

Fully Automatic

FULLY automatic in operation, this spraying and stoving machine is intended for fast and economical finishing. Suggested users include manufacturers of toys, fancy goods, hardware, electrical instruments, and motor car accessories.

Designed to provide a high work output from limited floor space, the unit is totally enclosed to prevent dust settling on newly-painted work. It is claimed that operation by unskilled labour is easy. Controlled paint application is reported to be ensured, with minimum paint overspray waste and consistent process time for flash-off of solvents, stoving and cooling. A metal pre-treatment station, to enable complete processing without handling, is available as an extra. The machine incorporates a full range of stroke adjustments. One or more traverses can be fitted to a unit with a complete series of motions, including vertical, horizontal, arc spraying and internal coating. It is claimed that any form of stoving can be incorporated, including infra-red, forced



draught, or a combination of both, using gas, electricity, oil, or steam as the heating medium. The paint extract system has filtered air inlet and combines a water-curtain rear sheet with scrubbing by water jets.

The unit, which is custom-built to suit individual layouts, outputs, and process times, is stated to be flexible. It is designed to spray at a pre-determined output, with the work set at 3 in pitch or multiples of that pitch. The power supply required is 400 V, 3 phase, 50 c/s. If desired the unit can be supplied in flameproof form for handling all classes of materials. *Automatic Equipment Limited, Daleside Road, Nottingham.*

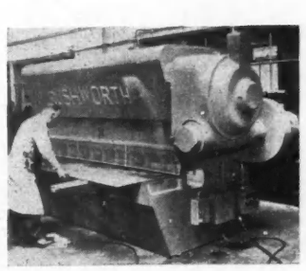
GUILLOTINE SHEARING MACHINE

Produces Clean Edge

DEVELOPED from the makers Series 25 guillotines, two new ranges of shearing machines have been introduced having larger capacity.

Of all-steel frame construction, these machines incorporate forward-sloping slideways and a low-rake angle of the top blade beam. These features are claimed to give a clean-sheared edge. The blades, which have four cutting edges, are adjustable over their full length. The Series 38 machines have mild steel capacities ranging from 6 ft by $\frac{3}{8}$ in to 12 ft by $\frac{3}{8}$ in. In the case of the Series 50 machines capacities are from 6 ft by $\frac{1}{2}$ in to 8 ft by $\frac{1}{2}$ in.

Drive is by worm and wheel, the electric motor and flywheel being mounted coaxially. Transmission is through a solenoid-operated multi-jaw dog-type clutch. Clutch control is by a foot or pendant switch. Hold-down is effected by individual hydraulic plungers which are operated from a master unit. The Series 38 range has an operating speed of 50 strokes a minute in the smaller-



capacity machines, and 37 strokes a minute in the larger-capacity units. The Series 50 models work at 33 strokes a minute. In all cases the depth of the gap is 9 in.

Equipment includes two table brackets for the front and two side guides for the top of the table. Lighting is provided on the cutting area. There is a chute to push cut-off blanks away from the machine. Optional extras include a shadow cutting line indicator and a dial-reading precision back gauge, which can be power operated, in lieu of the ungraduated standard gauge. *Rushworth and Company (Sowerby Bridge) Limited, Sowerby Bridge, Yorkshire.*

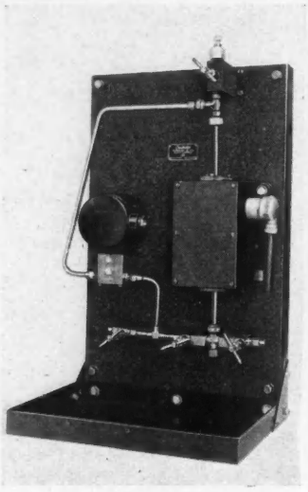
GAS ANALYSER

Determines Occluded Hydrogen

THE analyser illustrated has been produced to determine the presence of occluded hydrogen.

It is claimed that the simplicity of the equipment, and its ease of operation, offer advantages over estimation carried out in vacuo, particularly in relation to the greatly reduced time necessary for the test. The sample to be examined is heated in an inert atmosphere in a closed space and the concentration of hydrogen measured by a katharometer. Knowing the weight of the sample, the volume of the space, and the concentration of hydrogen, the original concentration of hydrogen in the material can be determined. It is assumed that the solubility of hydrogen in the material at the furnace temperature is small.

The apparatus is essentially a closed gas circuit, leading to a katharometer, which is a thermal-conductivity instrument with a greater response to hydrogen than to any other possible contaminant. A galvanometer-type indicator or a recorder is used. The former is suitable



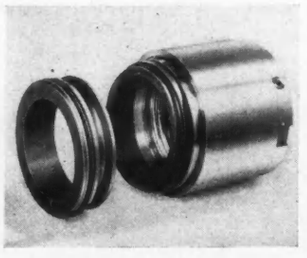
for routine tests, the latter is preferable for research or development work. *Cambridge Instrument Company Limited, 13 Grosvenor Place, London SW1.*

SHAFT SEALS

For High Pressure Service

TYPES 51B and 52B mechanical shaft seals have a designed nominal pressure ceiling of 1,500 lb per sq. in.

The performance life of these seals at high pressures is said to be superior to that of any mechanical shaft seal previously in standard production, this superiority being most marked in the higher range of shaft sizes and speeds. Drive is transmitted to the pressure-compensated carbon seal faces by drive keys and pegs. These seal faces ensure that external pressure will not disturb the parallel relationship of the seal face and the stationary seat. Extended surface seats promote the dissipation of heat generated at the area of contact between the seal face and the seat and are reported to eliminate overheating. The Type 51B is designed for service at temperatures ranging from $-40°$ C to $+100°$ C. Type 52B has a temperature range of $-80°$ C to $+250°$ C. Both types have generous allowance for axial movement. Type 51B, having rubber components, is suitable for sealing against



air, water, mild chemicals, solvents, lubricating oils, and refrigerants. The Type 52B has no rubber component and is recommended for highly-corrosive services. Both types are available in 18 sizes, ranging from 15 to 100 mm and rising by steps of 5 mm. Larger sizes are made to special order.

The shaft or sleeve on which the seal is fitted should be made from a corrosion-resistant material, having a minimum hardness of 125 Brinell. The shaft must be highly polished to 10 CLA or less. The seal illustrated is the Type 51B. *Crane Packing Limited, Berwick Avenue, Slough, Bucks.*

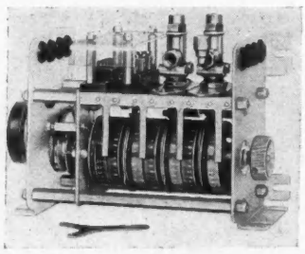
SEQUENCE TIMER

Switches Electric and Pneumatic Circuits

AN extension of the makers' range of sequence timers, the Magnacam timer can operate directly both switches and air valves.

It is claimed that the automatic control of tools and equipment will be simplified by the use of this timer, due to its ability to provide direct operation of pneumatic cylinders as well as control electrical equipment. The control cams are carried on a shaft mounted on self-aligning bearings spring-mounted in a steel chassis. Each switch or valve is operated by two cams, one operating the on and the other the off setting. A drum, calibrated in degrees, is attached to each cam and a further one indicates the camshaft position. It is reported that the cams can be set quickly and precisely with the aid of the peg spanner shown in the illustration. The use of large-diameter cams is said to reduce the minimum switched-on time to that resulting from 4° of rotation, or, if two switches are used in series to 1°.

The valves and switches are indivi-



dually replaceable and interchangeable. The valves are three-way units, with a $\frac{1}{8}$ in bore, suitable for pressures up to 80 lb per sq. in. The switches are SPDT units rated at up to 15A and suitable for voltages up to 440. As many as 24 pairs of cams can be fitted, but should the number required exceed 12, double camshafts are used. Camshaft speeds range from one revolution in 7 seconds times the number of cams, to about one revolution per week. Camshaft action can be: forward drive with automatic reset; forward drive only; or, with two motors fitted, forward and backward drive. *D. Robinson and Company Limited, 5 Church Road, Richmond, Surrey.*

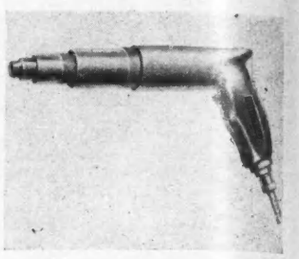
PNEUMATIC SCREWDRIVERS

Quiet Operation

MADE in Holland, a new line of pneumatically - operated screw - drivers and nutrunners, known as Grasso tools, is now available in Britain.

The nose shroud, used with slotted bits in guide sleeves, is claimed to render operation almost silent, a feature of particular importance where banks of tools are in use. The torque setting is said to be easily adjustable in the nose of the tools. Three different torque springs are supplied with each tool; in the case of screwdrivers having a straight body, torques up to 13½ ft-lb are produced, in the case of pistol-grip types these range up to 19 ft-lb.

The three straight-grip models run at 500, 900 and 1,500 rpm. They are powered by a vane-type motor using 9 cu. ft of air per min and have a capacity of ¼ in dia screws and bolts and No. 12 woodscrews. The five pistol-grip models employ a similar type of motor, taking 15 cu. ft per min. Speeds are 400, 600, 800, 1,000, and 3,000 rpm. Capacities are up to $\frac{5}{16}$ in dia screws and bolts and



up to No. 14 in the case of woodscrews.

When operating on a series of screws the trigger of the tool can be kept depressed, since the action of pressing the nose of the tool on the screw actuates the screwdriver. When withdrawn the bit remains stationary and is ready to engage with the next screw.

The weight of the straight-body type is 1¾ lb and that of the pistol-grip type is 2½ lb. The diameter of the hose inlet in both instances is ¼ in. In addition to the range of bits for slotted heads which is available, a ¼ in square drive socket adaptor can be supplied. *B. O. Morris Limited, Briton Road, Coventry, Warwickshire.*

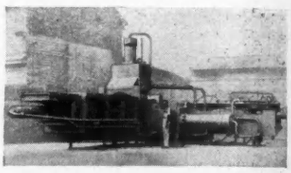
SCRAP-PROCESSING MACHINERY

Extensive Range

ARRANGEMENTS have been made for the manufacture and sale of Scrapmaster scrap-processing machinery in Britain. These machines are hydraulically-operated shears and baling presses. Shearing capacities range from 300 to 2,000 tons and bale weights from 20 to 6,000 lb each.

It is claimed that this equipment is fast, safe, and consistent in operation, is simple to handle and requires a minimum of maintenance. The shearing range is based on two types of machine. In one of these machines a baler-type charging box is incorporated, in the other a compression side-type charging box is provided. The baler-type box, which is claimed to be unique, is reported to enable scrap to be compressed into a high-density load prior to shearing into pre-selected lengths.

The automatic compression baler illustrated is the Sheppard Harris TGS200 series, intended primarily for baling light-gauge sheet and skeleton scrap. Production averages 18 to 20 tons per



hour. The bale size is 16 in by 20 in by 16 in and the average bale weight 600 lb, but both size and weight are variable. The dimensions of the press box are 50 in wide by 40 in deep by 120 in long. After charging the first-compression ram moves forward and shears any scrap extending above it, the second vertical-compression ram moves downwards, and the third horizontal-compression ram finishes the bale which is ejected. Two 100 hp 1,500 rpm electric motors each drive two 46 gpm Vickers vane-type rotary pumps at a working pressure of 2,000 lb per sq. in. The weight of the machine is approximately 60 tons and the floor space required 21 ft by 30 ft. The press box is lined with abrasion-resisting plate. The standard machine includes controls mounted in a free-standing panel. *Sheppard and Sons Limited, Bridgend, Glamorgan.*

HEAD HARNESS

Retains Headgear in Position

TO INCREASE the wearer's comfort and retain protective headgear in position, a new harness has been introduced.

A moulded-polythene spider cradle fits over the head; at the end of each leg of the cradle there is an adjustable device consisting of a nylon stud which can be moved up and down in a slot. This individual leg adjustment allows for alteration to fit the contour of the individual head, and replaces the draw string which was formerly used for general adjustment. Variation of circumference is obtained from the two nylon studs fitting into a series of two parallel lines of holes on each side of the band. This, as will be seen from the illustration, which shows the harness fitted into an Issguard hard hat, also enables the hat to be worn in a headsling style if desired, eliminating the need for a chinstrap save in gale or unusual conditions. The headsling style is reported to be not only more secure but often more comfortable.

Incorporated inside the top of the

cradle is a soft-foam plastic plate, which is claimed to eliminate the discomfort experienced by bald-headed personnel when wearing safety hats. An unalterable safety head clearance exceeding one inch is provided; a replaceable buffer band, distinct from the harness, provides protection at the back when the hat is worn in headsling style. The sweatband, consisting of a self-adhesive soft-plastic foam strip, is easily renewed. The polythene head harness may be readily cleaned and sterilized for re-issue. It is stated that the hat illustrated and the harness fulfil BS requirements, and as they contain no metal parts are particularly suited for use in the electrical field. The weight of the hat shown, complete, is approximately 1 lb. *Safety Products Limited, Holmethorpe Avenue, Redhill, Surrey.*

Companies

Firth Brown Teach Boys New Skills

A LONG period of providing technical training for young people stands to the credit of THOS. FIRTH AND JOHN BROWN LIMITED, Sheffield. The company is one which firmly believes, among other things, in giving their apprentices a thorough grounding in basic engineering skills.

A further step forward in the facilities available to the firm was made at the end of last month, when the company's new apprentice-training school was opened by Mr. W. J. Carron, the president of the Amalgamated Engineering Union. A few days before, Mr. Carron had opened a new training centre at Cowley for the PRESSED STEEL COMPANY LIMITED.

Among the new school's amenities is a large workshop specially equipped for instructing apprentice fitters and apprentice electricians in the requisite skills of their trade. This shop also contains a comprehensive range of modern machine tools to provide adequate practical training for apprentice turners. Another feature is a lecture theatre equipped with visual-aid apparatus for the assistance of the school's instructors and outside speakers when giving talks. The cloakroom and canteen facilities are of the highest order. Provision has also been made for private study.

The first Firth Brown training school was opened very shortly after the termination of the recent war and the amenities which it provided have been extended from time to time, but it had lately become apparent that there was a need for completely redesigned and much extended training facilities, if the firm's future requirements were to be met.

A Thorough Grounding Provided

A team of skilled instructors is being provided by the Firth Brown organization, under whose guidance apprentices at the school will probably spend from 18 months to two years. During the first few months, the youths will be given opportunities to work in each of the school's sections before moving on to more advanced training in one particular type of trade.

Apprentices will be taken stage by stage through the basic aspects of this chosen trade, until a satisfactory standard is reached. They can then be transferred to the firm's engineering departments, production machine shops or drawing offices for further training and instruction under other instructors.

A special feature of Firth Brown training is that all work undertaken in the school is of a useful character and that every effort is made to see that the work is interesting as well. Where parts have to be made for use elsewhere in Firth Brown's own works, the boys concerned in their production are encouraged to see what they have constructed in actual operation.

The accompanying illustration shows part of the new school's machine shop facilities and gives an indication of the building's well-lit and spacious construction.

How Important Is Brno Trade Fair?

This year's International Trade Fair at Brno, the third of the series, ended, as it had begun, in brilliant sunshine and on a cheerful note of success.

Dr. O. Koutsky, the fair's sales manager, speaking at the final press conference, said that the total trading figures for 1961, not immediately available, would show a satisfactory increase on those of last year.

A large majority of the 56 British firms represented at the exhibition expressed definite satisfaction at the results and general arrangements. At last year's event, only 35 British firms had shown their products, and this year's increased representation was an indication of the determination of the British engineering industry to seek new markets.

Germany, with 86 firms taking part, was again the foremost exhibitor from the western countries, and is still the largest western exporter to Czechoslovakia. This year, however, 160 British firms who have not yet exhibited at Brno sent representatives; an increase of exactly 100 over the 1960 figure. Some of the firms so represented, such as Vickers-Armstrongs have already declared their intention of participating next year.

The Brno Fair is the only specialist engineering exhibition to be held in the eastern bloc countries. Trade missions from all the eastern countries attend and British companies are able to make valuable contacts with these countries generally as well as with Czechoslovakia itself. Attendance at the fair in 1961 was 1,300,000, but this figure included only 25,000 foreign visitors (about 2 per cent).

This year, exhibits from all countries were shown in their appropriate groupings, and not in national pavilions as in the past two years. This arrangement was universally popular. There was a Hall of Nations where countries could stage prestige exhibitions and run information centres. Our own Board of Trade were represented there this year for the first time. It appears that a satisfactory number of inquiries have been received by British firms, not all of which have been from Czechoslovakian firms. Interest has been shown in controlling instruments, mining equipment, optical and measuring equipment, woodworking machinery, gear-grinding machinery, lathes, printing presses, and capital equipment. Inquiries for navigation equipment were received from Poland.

Brno Fair seems now to have established itself quite firmly. Indeed, the main difficulty next year will be to find space for all the firms wishing to participate, especially as the Czechs do not intend to enlarge their covered space in 1962.

An interesting point is that, in July next year, Czechoslovakia is due to stage an exhibition in this country at the Empire Hall, Olympia, London W14.

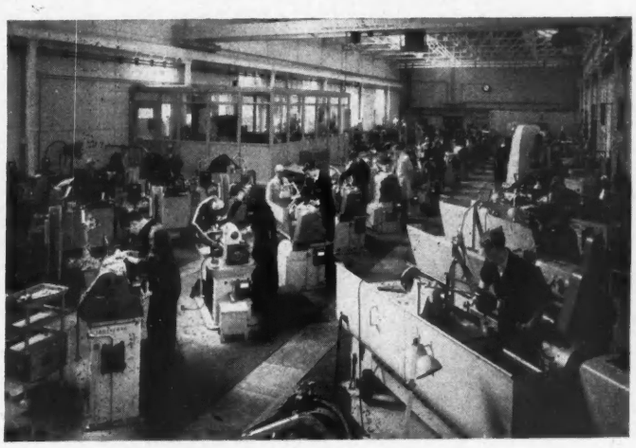
Diversifying Industry on the Clyde

On 25 September a new factory for AIRCRAFT-MARINE PRODUCTS (GREAT BRITAIN) LIMITED was opened by the Rt. Hon. J. S. Maclay, M.P., C.M.G., Secretary of State for Scotland. The factory is situated on the Industrial Estate, Port Glasgow, and employs about 300 personnel.

Aircraft Marine were founded in 1955; the firm having been originally established in the United States in 1941 and, since the recent war, there has been an extensive expansion. There are now plants operating in Great Britain, France, Italy, Holland, West Germany, Canada, Australia, Mexico, Puerto Rico and Japan; the headquarters of the parent company are at Harrisburg, Pennsylvania.

The new factory at Port Glasgow has an area of 60,000 sq. ft and will increase the production of the AMP solderless terminals, connectors and associated products. AMP products are being used throughout a wide section of the engineering industry, ranging from domestic appliances to aircraft. For example, the Boeing 707 uses approximately 13,000 AMP terminals, and there are many openings in the present expanding electronics industry and for use with printed circuit boards.

The factory will bring employment to the Port Glasgow district, where the unemployment level is high, and it will help to diversify the industry in an area which is very dependent on shipbuilding and heavy engineering. At the moment only 10 per cent of AMP's products are exported, but the factory also supplies the tooling for the European members of the organization.



A new training school was opened last month by Thos. Firth and John Brown Limited. A view of the school's extensive machine shop facilities is shown above.

From Brighton to County Down

A recently-constructed government-built factory at Newtownwards in County Down, Northern Ireland, which was formerly in the occupation of LEE GUINNESS LIMITED, has now been acquired by ALLEN WEST AND COMPANY LIMITED of Brighton.

This acquisition will provide continuity of employment for the factory's skilled labour force, most of whom are men, and Allen West confidently expect that the total strength employed there will be increased to around 400 persons within the next three to four years. The factory has 56,000 sq. ft of floor space, with ample room for expansion and will go over immediately to the assembly and wiring of standard Allen West contactor panels.

It is the firm's intention that the post of works manager shall be filled locally. Other employees will also be recruited in Northern Ireland, as required. It is not intended that any of the Allen West's Brighton staff shall be permanently transferred to Ulster, where the company will continue to be represented by WILLIAM REAY (BELFAST) LIMITED.

Allen West, who were established in 1910, have subsidiary companies in Canada, Rhodesia and South Africa, as well as an associated concern in France. They occupy a leading position in the Commonwealth in the manufacture of electric motor-control gear.

Some New Company Appointments

Lord Dudley Gordon, D.S.O., M.I.Mech.E., has resigned as chairman of HADFIELDS LIMITED, Sheffield, and Sir Peter G. Roberts, Bt., M.P., has been elected to fill the vacancy. Lord Dudley has agreed to remain a member of the board as an ordinary director of the company until their annual general meeting, which is expected to be held during February. It is then his intention to retire as he approaches his 80th birthday.

New appointments have been made in connection with the small tools and equipment division of A. A. JONES AND SHIPMAN LIMITED, Leicester. As from the beginning of next month, Mr. P. Farnsworth will become export and commercial sales manager and Mr. W. Disney will be the manager for home sales and equipment.

These appointments are being made to accommodate the further expansion of the department and to cope with the increasing demands for the firm's products. Greater production facilities have been available for the manufacture and sale of Jones and Shipman's small tools and equipment since the recent self-contained extension to the main factory.

Mr. R. Ferguson, O.B.E, will retire from the position of managing director to the MARCONI INTERNATIONAL MARINE COMMUNICATION COMPANY LIMITED at the end of this year but will retain his seat on the board. He will be succeeded as managing director by Mr. D. P. Furneaux.

High-Pressure Nylon Hose in Hydraulics

A make of high-pressure nylon hose is claimed to have many advantages over braided rubber. Comments from five users are recorded here.

ACCEPTED practice for high-pressure hose has been to use all-metal construction or to reinforce rubber hose with metal wire to increase the pressure rating. Generally speaking, all-metal hose has been superseded by wire-reinforced rubber hose and many millions of feet of the latter are being used each year with the increased use of hydraulics on plant and machinery.

Tecalemit are now producing a high-pressure nylon hose, and this, they say, is already being accepted as setting a new standard for hydraulic applications. It consists of a nylon inner core braided with high-tenacity synthetic yarn with an outside extruded nylon cover.

This form of construction is claimed by the makers to offer advantages over conventional high-pressure hose. Technically the most important of these is an improvement in fatigue life under conditions of pressure fluctuation and flexing. The good fatigue resistance of the high-tenacity synthetic braid may increase the life of a hose up to seven or eight times that of equivalent braided rubber hose used under similar conditions.

Other advantages of this hose listed by Tecalemit include its small outside diameter in relation to bore size; high abrasion resistance of the outer cover; small inside bend radius, which is the same for both flexing and installation bends; low resistance to flow by the smooth bore; excellent low temperature performance normally rated down to −40° F but remaining flexible at temperatures much lower than this; extreme resistance to all mineral and vegetable oils; and high resistance to many chemicals and gases which have a bad effect on rubber.

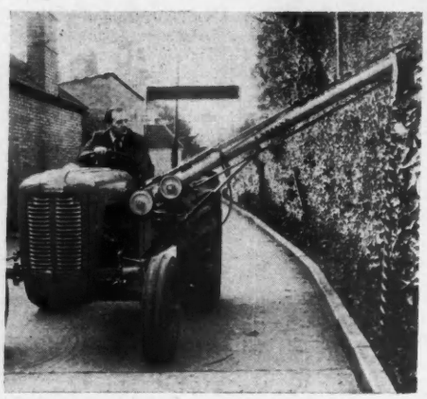
High-pressure nylon hose is offered by Tecalemit with a full range of reusable end fittings. They say that no preparation of the hose is required before screwing the ferrule or sleeve into the outside of the hose. These end fittings have been designed to give the least possible resistance to flow and to have a larger bore than most equivalent end fittings for rubber hose. This feature, with the easy flow through the smooth nylon bore, results in a high overall efficiency. Tecalemit report that tests have established that in many cases a small bore high-pressure nylon hose can be used in place of a large bore rubber hose.

Tecalemit Limited, Plymouth, Devonshire.

Stacking and Loading Clamp

The Ransomes, Sims and Jefferies fork lift truck shown below incorporates a Fortress clamp attachment specially designed by G. H. Bennett of Plymouth. This type of clamp eliminates the need for pallets and is claimed to be particularly useful for handling bricks, blocks and general precast concrete work. The hydraulic system is fitted with Tecalemit high-pressure nylon hose of $\frac{1}{2}$ and $\frac{3}{8}$ in i.d. (The fork lift truck, incidentally, also uses such nylon hose.)

G. H. Bennett first proved this hose in one of their clamps for use in handling precast concrete. In operation it called for $\frac{1}{2}$ and $\frac{3}{8}$ in bore hoses to run over masthead sheaths. After years of operation which involved working every day, with pressures ranging from 250 to 2,000 lb per sq. in simultaneously with movement of the hose over these sheaths, the firm say that no maintenance was required. In the past they had experienced frequent bursts with steel-braided rubber hose, resulting from the severe chafing and abrasive conditions met in such operations.

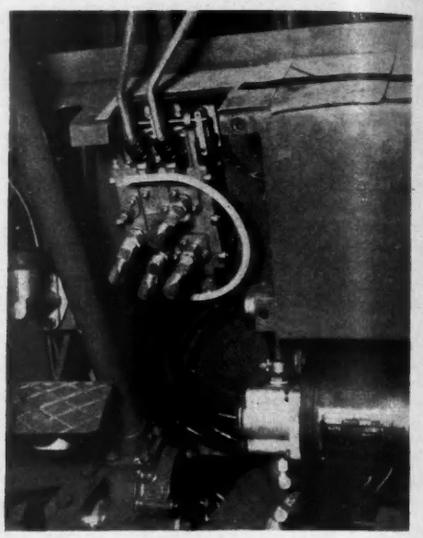


Hedge Trimmer

Pressure relief valves set at 2,500 lb per sq. in are used in conjunction with $\frac{1}{2}$ in i.d. nylon hose on the Twose hedge trimmer attachment made by E. V. Twose of Tiverton (see illustration above). This firm say they have found the hose satisfactory, but are considering the adoption of a new hose which Tecalemit are introducing which has even greater flexibility than the previous type.

Front-End Loader

David Brown/Albion trailers, forage harvesters and front-end loaders all make extensive use of hydraulic control. The illustration here shows a tractor fitted with one of these front-end loaders. Tecalemit high-pressure single-braided $\frac{3}{8}$ in i.d. nylon hose is used throughout the system. Tecalemit say that this has been found to give excellent service and that among other things their customers have praised the smooth outer cover; this is oil and dirt resistant and can be maintained in original condition by an occasional wipe down.



Fork Lift Truck

A new model of fork lift truck recently introduced by Lansing Bagnall is called the Rapide. High pressure nylon hose of $\frac{3}{8}$ in i.d. is used throughout the hydraulic system and is fitted as original equipment (see detail above).

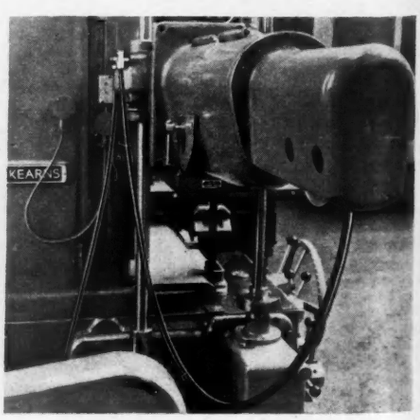
Lansing Bagnall are reported to have given the hose exhaustive tests before giving it approval for use on fork lift trucks. Tecalemit say they find that the good resistance to chafing—which is sometimes a cause of trouble with rubber hoses—is a feature which this user finds attractive.

Hydraulic Tool Release

On this 451P Optimetric boring machine made by H. W. Kearns is a hydraulic tool release fitted with high pressure nylon hose. H. W. Kearns say that they chose the nylon hose because its small diameter and bend radius allowed it to be used with a small size of pulley.

One size of Tecalemit nylon hose only is used on the hydraulic tool release equipment; this is of $\frac{1}{2}$ in i.d. and operates in this application at 300 lb per sq. in. Flexing around the 6 in diameter pulley occurs when the spindle is traversed, but flexing does not take place under pressurized conditions.

This machine manufacturer says that high pressure hose of $\frac{3}{8}$ in i.d. is also used for the hydraulic clamping of slides. A change from rubber hose was made in this application because of the smaller physical dimensions of the nylon hose and the more simple end fittings. End fittings are fitted in their works without difficulty.



Modified Stainless Steel

Samuel Fox and Company announce an addition to their Jethete range of high strength stainless steels for elevated temperature service. Known as Jethete M153, it is a 12Cr-Ni-Mo-steel with impact properties and ductility which are claimed by the makers to be better than with Jethete M152.

This alloy has been developed for structural applications where the high strength of Jethete M152 is not called for, say Samuel Fox, and this has been achieved by the elimination of canadium and a lowering of the molybdenum content. This improves the hot workability and enables a small price reduction to be made.

Jethete M153 is now commercially available in the form of billets, blooms and slabs for forging and re-rolling, and bars and turned rounds for machining or forging. A technical data sheet is available from the makers.

United Steel Companies Limited, Broomhill, Sheffield 10.

King Pin Shrunk With Liquid Nitrogen

A 2 ft long and 11 in wide king pin with a 6½ in bore was recently shrunk by liquid nitrogen to fit into a dragline chassis under repair by Slag Reduction Limited of Rotherham. By immersing the king pin in liquid nitrogen for 25 minutes its diameter was reduced by 0·021 in.

Four outriggers, each 4 ft long, were also nitrogen shrunk for 30 minutes to reduce their diameters by an average of 0·013 in on 7⅛ in. The illustration shows the diameter of one of these outriggers being checked after shrinking.

British Oxygen, who supplied the liquid nitrogen, comment that this repair job was quicker and cheaper than machining and pressing and eliminated the risk of distortion. A total of about 27,000 (gaseous) cu. ft of liquid nitrogen was used during the shrinking, 7,000 cu. ft for the king pin and an average of 5,000 cu. ft for each of the outriggers.

British Oxygen Company Limited, Cleveland Row, St. James's, London SW1.

Chromate Coatings for Brass and Zinc

Two additions have been made by Walterisation Company to their series of chromate conversion processes. The original one was for aluminium and this is now called Cromcote AL. The new additions are for brass, Cromcote BR, and for zinc, Cromcote ZC or ZH.

The first addition is a chromate treatment for brass and other cuprous alloy surfaces. The makers consider that it will be of value in preventing tarnishing and finger marking.

The two processes for zinc are intended respectively for use on massive zinc and on galvanized steel surfaces. Use of Cromcote ZC under the correct conditions is intended for production of a corrosion protection and paint-bonding surface. Cromcote ZH is a special development of the last mentioned process designed for treatment of newly galvanized work.

Walterisation Company Limited, Purley Way, Croydon, Surrey.

Rubber Bags Used as Gasholders

The problem of storing gas and supplying consumers while repairing holders at three small gas works where no alternative storage was available, was solved in a novel way by the Northern Gas

Board, report Dunlop Rubber Company. Inflatable rubber bags were used which could be folded up and stored when not in use.

The rubber bags, of which one is shown, were specially made by the General Rubber Goods Division of Dunlop at Manchester. They are rectangular in shape, each 35 ft long, 15 ft high and 15 ft wide with a capacity of 7,500 cu. ft.

The fabric from which they were made is a nylon weave coated with neoprene. Weft and warp strengths are claimed to be in excess of 250 lb per sq. in. The material is 0·025 in thick and the bags fold up into packages 8 ft by 3 ft by 2 ft weighing 640 lb. To provide a minimum district pressure of about 4 in water gauge, the top of the holder had to support 8½ tons of ballast.

Apart from prior rough levelling of the site and casting four concrete conrer blocks, Dunlop say that the holder took 48 man-hours for erection. They add that the structure can easily be dismantled, transported, stored and re-erected.

Dunlop Rubber Company Limited 10-12 King Street, St. James's, London, S.W.1.

Production Heats of Uranium-Steels

Ever since the decline of the market for uranium for defence purposes, additional uses of uranium have been sought, writes W. C. Kimball of Algoma Steel Corporation in the *Financial Post*, July 15, 1961. Following promising work by the Mines Branch of the Department of Mines and Technical Surveys, three production heats of uranium-steels were produced at Algoma.

The first Algoma heat was made into grinding balls to used grind ore for mineral recovery. It is hoped that the increased resistance to corrosion pitting and the increased fatigue life will result in longer life for the grinding balls.

The second and third heats will be processed into seamless tubing for the oil industry. Here pitting corrosion has been a very serious problem, particularly with many of the high sulphur Canadian oils. It is believed, Mr. Kimball continues in his article, that the improved resistance to corrosion pitting will greatly lengthen the life of seamless tubing used in oil wells and in refinery tubing.

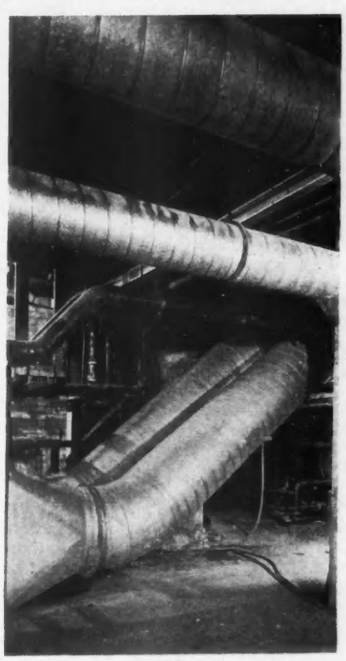
Another Canadian steel producer, Atlas Steels, is reported in the same article to have recently joined Algoma as a producer of uranium-treated steel. They have made a production heat of drill rod steel containing uranium. It is hoped that the increased fatigue strength will result in a longer life of the drill rods.

At the end of the first phase of research, the Mines Branch indicated that uranium-steels might be useful from several points of view. They disclosed that small additions of uranium reduce the tendency to corrosion pitting. This does not mean that the steel is corrosion resistant, comments Mr. Kimball, since uranium-steels will rust just as easily as non-uranium-treated steels; however, the rust is uniform and is not concentrated in pits . . . which often results in failure of the steel far short of its expected life.

Spiral Conduit With Sealing Ring

Spiral conduit is now being made by Metal Sections of Oldbury which incorporates a sealing strip of rubber mastic. They claim to be doing this by a new technique.

The rubber mastic sealing compound is made by Minnesota Mining under the number EC750C.



Metal Sections say it provides an airtight tube, preserves the lock-joint from rough treatment during transit and on site, and allows for expansion and contraction of the joint.

The makers state that they have successfully carried out leakage tests on the new tube up to a static internal pressure of 15 lb per sq. in and that their Helitube is being marketed with this leakproof assurance.

The modification (from metal to metal jointing) is being incorporated in all Metsec Helitube. This product is available from 3½ to 24 in diameters and in three gauges: 25, 22 and 20 swg, in any suitable ductile metal.

The illustration shows some of the sealed spiral ducting fitted at the Imperial Cancer Research Fund Centre at Lincolns Inn Fields, London. The makers suggest one should note how the 24 in diameter Helitube requires very little support with ceiling brackets.

Metal Sections Limited, Oldbury, Worcestershire.

Heavyweight High Precision Engineering

Technical progress in the steel industry now demands very high standards of precision engineering, sometimes of components weighing more than 150 tons. This requirement for precision has been reflected in the production processes at a factory making rolling mills, forging presses and associated equipment.

SINCE the last war the steel industry in this country has taken a great leap forward and more than doubled its output. During this period steel making methods have been transformed into highly scientific and precise processes. This transformation has, in turn, presented the manufacturers of steel making plant with the problems of working to unprecedentedly close limits and of providing accurate and immediate control over the product.

At the Darnall works of Davy and United Engineering, who design and make more than half of the British output of rolling mill plant, this necessity for working to very close limits has produced an impressive combination of heavy and precision engineering. In the same works, another Davy-United company, Davy and United Instruments, has developed and is manufacturing a range of electronic instruments for controlling the width and thickness of steel strip to very fine limits. The layout of the Darnall works, where 2,700 of Davy-United's 8,800 employees work, is shown in Fig. 1.

Perhaps the most notable contract met by the company in recent months was their share of the contract for the new integrated iron and steel works at Durgapur in West Bengal, built for the Indian Government. Of the £29 million worth of plant supplied by Davy-United for this contract, £7 million worth was produced at Darnall. A list of other large contracts handled by the company in the last few years is given in the table and an example of a finished product in action is shown in Fig. 2, where the cold rolling plant commissioned this year at the Brinsworth mill of Steel, Peech and Tozer is operating.

The Darnall works was established on its present site in 1921 and now covers approximately 24 acres. Among the crucially important parts of the manufacturing process are the shop layouts and production planning and control. The layouts are important because it has been necessary to utilize the available space as fully as possible, an aim which has been made the more difficult to fulfil by the fact that many of the components carried and temporarily stored between machines are extremely bulky.

However, this problem has been met successfully, as has the related problem of ensuring effective production planning and control. Tight production control has been necessary not only because both the floor space and the expensive machinery and plant must be kept fully utilized, but because the large contracts normal in this industry involve routing a number of different items through the works for completion at approximately the same time. The plant made to meet a particular contract does not become saleable until the last item of the contract has left the production lines, so that bad planning and control could result in a build-up of unsaleable part-contracts.

Some Contracts Fulfilled in Recent Years

(*a*) 42 in blooming mill, 45 in slabbing mill and 12 ft wide plate mills at Appleby-Frodingham;
(*b*) Blooming and continuous billet mill at Lysaght's, Scunthorpe;
(*c*) 80 in reversing cold strip mill and 42 in slabbing mill at John Summers & Sons, Shotton;
(*d*) Two wide tandem and temper cold strip plants for the aluminium industry;
(*e*) Solid wheel plant at Steel, Peech and Tozer's Ickles Works;
(*f*) Blooming and continuous billet mill plant at Consett;
(*g*) Blooming and section mill plants for Norway and Spain;
(*h*) £8 million worth of slabbing, strip and skin pass mills at The Steel Company of Wales;
(*i*) 42 in five-stand tandem cold strip mill at Richard Thomas and Baldwins;
(*j*) 52 in blooming mill and continuous billet, merchant and rod mill plants at Dorman Long's Lackenby Works;
(*k*) 150 in wide plate mills at South Durham and Consett.

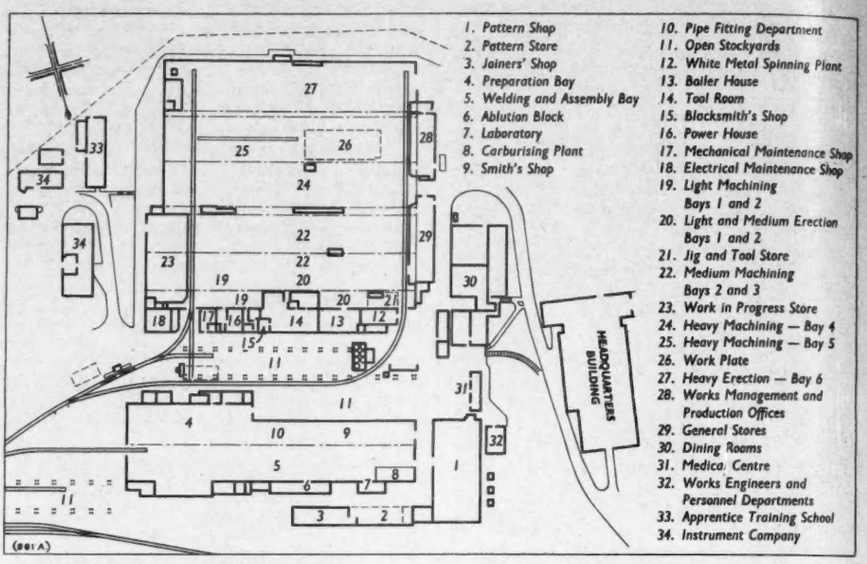

1. Pattern Shop
2. Pattern Store
3. Joiners' Shop
4. Preparation Bay
5. Welding and Assembly Bay
6. Ablution Block
7. Laboratory
8. Carburising Plant
9. Smith's Shop
10. Pipe Fitting Department
11. Open Stockyards
12. White Metal Spinning Plant
13. Boiler House
14. Tool Room
15. Blacksmith's Shop
16. Power House
17. Mechanical Maintenance Shop
18. Electrical Maintenance Shop
19. Light Machining Bays 1 and 2
20. Light and Medium Erection Bays 1 and 2
21. Jig and Tool Store
22. Medium Machining Bays 2 and 3
23. Work in Progress Store
24. Heavy Machining — Bay 4
25. Heavy Machining — Bay 5
26. Work Plate
27. Heavy Erection — Bay 6
28. Works Management and Production Offices
29. General Stores
30. Dining Rooms
31. Medical Centre
32. Works Engineers and Personnel Departments
33. Apprentice Training School
34. Instrument Company
HEADQUARTERS BUILDING

Fig. 1 The layout of Darnall works, showing the relative positions of the different departments.

PRODUCTION PROCESSES

The relative positions of the different departments are shown above in Fig. 1. Production begins in either the pattern shop or the fabricating department, according to whether the component concerned begins life as a casting or as a piece of sheet or section in the raw material stockyard. The modern tendency has been to extend the use of fabrications, particularly for components such as gear wheels, but it will always be technically and economically necessary to cast some components.

The pattern shop has been considerably extended and mechanized in recent years. Invariably, the principal units of rolling mill and forging press plant are large and heavy pieces which, in the "as cast" state, often weigh well over 125 tons each. On this scale, the completed patterns can often be as much as 29 ft long by 9 ft wide by 14 ft deep and weighing 10½ tons. The pattern for the crosshead of a large forging press, for example, weighs over 10 tons.

The heavy fabrication department, said to be capable of an annual output of 6,000 tons of weldments, consists of plate and section stockyards feeding into a 210 ft by 60 ft preparation bay, where material is marked out and cut or pressed to shape, and a 480 ft long and 60 ft wide main assembly and welding bay. Equipment in the preparation bay includes capacity for gas cutting plates up to 40 ft long and 15 in thick, with electronic control up to 12 in thick; 200 and 150 ton hydraulic presses; a 400 ton vertical bending press; rolls for bending plates up to 10 ft wide by 1 in thick into 2 ft or more diameter cylinders; and cranes of 5 and 10 tons capacity. Individual weldments of up to 60 tons can be handled in the main welding bay and there are cranes of 7½, 15, 25 and 40 tons capacity. At one end of the welding bay is a gas carburizing plant, for the case hardening of gears, which can process pinions up to 30 in in diameter and 6 ft in overall length.

The machine shops are laid out in five bays. Bay 1, 450 ft by 30 ft, is for light machining and erection; Bay 2, 450 ft by 60 ft, is for light and medium machining and erection and for gear

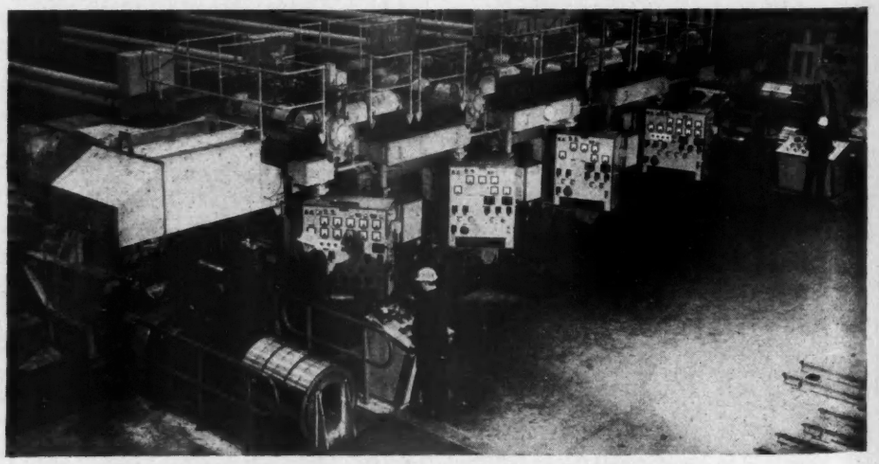


Fig. 2 A Davy and United Engineering product. The four-stand four-high cold rolling mill at Steel, Peech and Tozer's Brinsworth Mill.

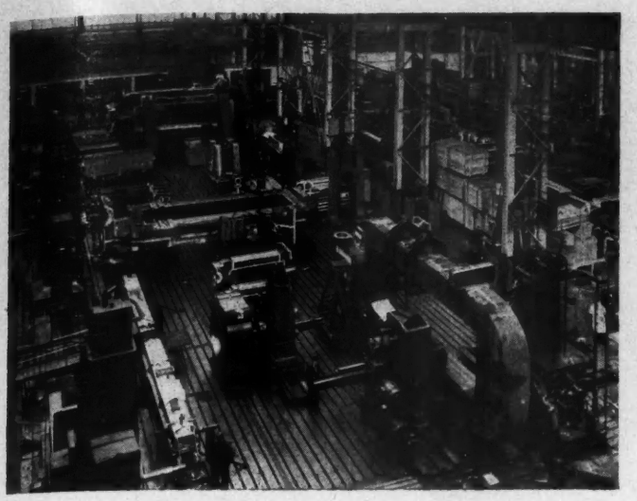


Fig. 3 The workplate in Bay 5 supporting a total weight of 580 tons during simultaneous machining of three plate mill housings.

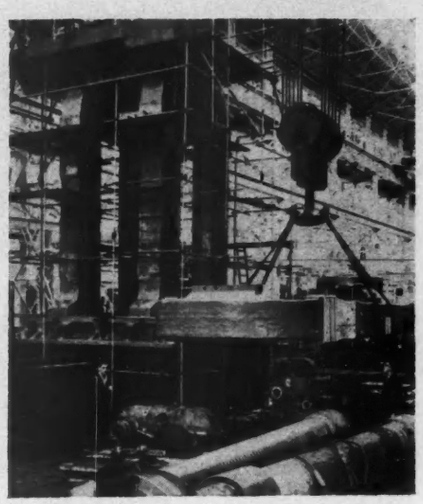


Fig. 4 A finishing stand for the Spencer Works hot strip mill under construction in the heavy erection shop.

cutting; Bay 3, also 450 ft by 60 ft, is for medium machining; and Bays 4 and 5, both 420 ft by 70 ft, are for heavy machining.

In Bay 1 work is of a conventional nature and is carried out chiefly on a battery of small centre lathes, a group of turret and capstan lathes, some planing and milling machines and a group of larger centre lathes. Machines in Bay 2 include table boring machines, horizontal planers and a section for machining small bushings and sleeves for Morgoil bearings.

In this bay, the gear cutting section includes a Liebherr universal gear hobber (equipped with a fully automatic single indexing device used for roughing operations before final generation by hobbing) able to hob spur and helical gears of 126 in diameter, 59 in face width and 0·85 diametrical pitch, and pinions up to 55 in face width. A second hobbing machine with a capacity of 74 in diameter and 21½ in face width and 1½ diametrical pitch is included.

The light and medium erection work in Bays 1 and 2 ranges from sub-assemblies to complete units of rolling mill auxiliary machinery such as reels, coilers, roller levellers and small shears.

In Bay 3, the 55 machines include double and single table type vertical borers, various vertical millers, planing machines, a 6 ft plano-miller, radial and horizontal drilling machines, two groups of centre lathes and a grinding section. The latter section includes a Naxos-Union plain roll grinding machine (there is a smaller one in Bay 2) which has been specially adapted for the grinding and mirror-finishing of large Morgoil bearing sleeves up to 56 in in diameter.

HEAVY MACHINING

The *pièce de résistance* of the works is the heavy machining in Bays 4 and 5. In these two bays single pieces weighing anything from 100 to 175 tons are handled and tooled and, in fact, the particular skill in heavy mill engineering is primarily in the accurate and economical machining of such large workpieces. At Darnall works, it is considered that their heavy machining is as fast and as modern as anything in the world.

Because the modern rolling mill is itself a high precision machine, high precision is required in its manufacture. Even on roll housings weighing as much as 175 tons, the machined surfaces of the housing windows, which carry the bearing chocks for the mill rolls, are required to be square both horizontally and vertically to within 0·003 in or 0·004 in. Another example is that the relative centres of the work roll and back-up roll chock bores on a modern four-high mill must be vertically lineable to within 0·0015 in, even on chocks weighing as much as 15 tons each. This combination of great weight and precisional accuracy is the central problem for the heavy mill production engineer.

Heavy crane capacity is, of course, vital. In Bay 4 there is an overhead crane with a main hoist of 100 tons and an auxiliary hoist of 20 tons together with a further 20 ton main crane with a 5 ton auxiliary. In the next bay, No. 5, there are a 150 ton crane with a 25 ton auxiliary hoist, a 100 ton crane with a 20 ton auxiliary, and a 20 ton crane with a 5 ton auxiliary. A lifting beam has been designed to link the main hoists of the heaviest cranes so that their combined capacities can be available for workpieces heavier than 125 tons.

Machines of particular interest in Bay 4 include a 14 ft Craven horizontal planer with a 27 ft stroke, a Loudon horizontal and vertical planer capable of planing 20 ft horizontally and 15 ft vertically, and a battery of six horizontal floor type boring, milling and drilling machines with spindles up to 8⅝ in diameter, probably the most useful general purpose tool of all in this class of engineering. Other machines in this bay are an Asquith 9 ft radial driller, centre lathes of 36 in and 42 in capacity, a 42 in slotting machine and, at the end of the shop, an 8 ft 6 in by 8 ft by 6 in by 26 ft stroke Kendall and Gent four-head plano-milling machine with individual 40 hp motors on each head. The rigidity of this machine and the power available have made it necessary to develop a new range of tungsten carbide cutters claimed to be much in advance of those commercially available. By making adjustments to the cutters themselves, it has been possible to simulate the effect of milling at 100 hp. Nearby is a 30 ft by 18 ft marking-off table which can support a load of 120 tons.

Bay 5's array of heavy machining equipment includes a 10 in spindle Harvey horizontal borer, two further Loudon horizontal and vertical planers, a 17 ft 6 in Froriep vertical borer, and a 13 ft Waldrich planer with a stroke of 26 ft 3 in. This latter is a really massive affair, weighing 270 tons and being mounted on a 700 ton reinforced concrete base. The machine table is capable of taking a job weighing 150 tons and is operated by a dual electric drive supplied by a Ward Leonard system with a maximum input of 370 hp.

Of particular interest in this bay is a 10 in spindle ram type post milling machine, built by Asquith and said to be the biggest ever made in this country. It is rated nominally at 85 hp for any position of the spindle or ram, but, in fact, it is capable of running at 100 hp for two hours continuously, and has a horizontal traverse of 46 ft and a vertical traverse of 15 ft, while the ram can extend forward 5 ft and the spindle a further 6 ft in advance. A long reach right-angle attachment can transmit approximately 70 per cent of the full power.

The combined feeds are controlled electronically so that the feed rate remains constant regardless of the direction of motion. All essential controls are mounted on a pendant, itself power operated, which has been developed by Davy-United in conjunction with the makers to give efficient control on large workpieces.

On the heavy components in rolling mill and forging press engineering the time necessary for handling, inter-operational movement and setting up is a very considerable item. To reduce this time factor, in the interests of high machine utilization, the company conceived the idea (since used elsewhere) of bringing the machine to the job, instead of the job to the machine using the workplate shown in Fig. 3.

It consists of a cast iron floor plate 130 ft by 60 ft and weighing 700 tons, laid in 15 sections all 15 in thick and supported on adjustable jack screws. Part of the 130 ft length of one side is swept by the spindles of two large horizontal boring, milling and drilling machines installed in a pit alongside, while the 10 in ram type post milling machine is mounted transversely across the end of the workplate. Several other smaller machines are mounted on the plate itself and can be moved to any position on it.

After heavy machining in Bays 4 and 5, comes heavy erection in Bay 6 which, being 420 ft by 80 ft with a height to the crane rails of 50 ft, is big enough for the complete building up of the largest mill units for dispatch. Special erection beds laid on the shop floor are capable of supporting the heaviest assemblies envisaged in rolling mill engineering, and cranage is provided mainly by 125 ton and 50 ton overhead cranes with auxiliary hoists of 25 tons and 15 tons respectively. It has been known for as many as four major mill units to be under erection in this shop at one time. In Fig. 4, one of the finishing stands of the hot strip mill for the Spencer Works of Richard Thomas and Baldwins is shown during construction.

CONTROL INSTRUMENTATION

While the engineering works is producing the massive but finely accurate hardware for rolling mills, the adjacent instrument company workshops are meeting the corollary need for electronic control devices. In particular, the system of automatic gauge control, originated by the British Iron and Steel Research Association, has been developed by the Instrument Company and installed in many mills, both at home and overseas. By automatic gauge control, the gauge of rolled strip can be consistently controlled to within ± 0·0003 in by automatic adjustment of the rolls and tension.

Thus, the Davy and United Engineering and Instrument companies between them have achieved the combination of heavy engineering, precision engineering and electronic control now demanded by modern steel making techniques. This is one field, however, in which the home market alone cannot be expected to sustain the production capacity, particularly now that most British steel companies are nearing completion of their main expansion programmes, and so it is to be hoped that Davy-United will be able to improve their already good export record.

Davy and United Engineering Company Limited, Darnall Works, Sheffield 9.

On the Shelf

By Frank H. Smith

LAST year I gained considerable lustre when, due to my announcement that ENGINEERING were giving away a wall-chart calendar forecasting exhibishes and the like, the Post Office put on extra vans. This year the magnanimity boys inserted the 1962 version in the issue for 15 September but if extra copies are wanted or you've not had it (loose inserts have a habit of disappearing after the first name on the distribution list) drop a card to 36 and say I sent you. Or just say, "In re O.T.S."—they'll get the message all right. They're with it boy, they're really with it. Head your card "Events in Advance."

Collet's (45 Museum Street, London WC1) have a weakness for overwhelming one with booklists, etc., run off on the duplicator. It comes as a change, therefore, to get a 280 page catalogue of the USSR periodicals for 1962. Each item is translated into several other reasonable languages and is indexed all over the place.

You know those window envelopes that reveal the consignee's name typed somewhere on the contents? Well, if the latest bulletin from Microcard Editions Inc. had been sent to me in one of those it would have gone to Chief, Scientific and Technical Reference Section, General Reference Division, National Diet Library, Tokyo. Lucky it wasn't something I should not have seen. As it is, it is chiefly about a microcard copier which automatically provides blows-up (blow-ups?) from micro-opaques. If you want information about this $950 job write to Microcard Reader Corp., West Salem, Wisconsin. That 950, by the way, is f.o.b. West Salem.

Mechanical Engineering (ASME) for September 1961 has three pages on the move of the Engineering Societies Library to their new building. Quite an interesting thumbnail sketch, with a sub-title "Supported by more engineering societies, it will cover more fields in greater depth." That precludes aerial crop spraying anyway.

Shell-Mex and BP Ltd. (Shell-Mex House, London WC2) have sent along their *Film Library Catalogue 1961-62*, and the Central Film Library (Government Bldg., Bromyard Avenue, London W3) announce their main catalogue for the same period. The first is buckshee but for the second you must send 4*s* 6*d*. The CFL do a *Films for Industry* catalogue as well at 3*s*.

Johnson Reprint Corp. (17 Old Queen Street, London SW1, and 111 Fifth Ave., New York 3) now offer a reprint of the first 10 volumes of *Journal of Applied Mechanics*. $150 the set (paper bound) or $15 a single volume.

Methuen (36 Essex Street, London WC2) announce their second list of University Paperbacks, which includes Lawden's *Mathematics of Engineering Systems* at 12*s* 6*d*.

I do not know a thing about the ethics of book publishing but I certainly received a shock recently when I was offered an American official publication by an English publisher who pointed out that this item was also being done by an American house at a lower charge. But the English publisher had put the book out in loose-leaf form and by so doing was beating the other crowd by quite a respectable length of time. Would I mention this in my review?

If you are troubled with bladwesp, mouche a scie, Blattwespe, bladhveps, bladstekel, avispa or Tenthredinidae you will need the 8-language *Horticultural Dictionary* from Interscience at $7·50 to find out that it is the English sawfly. I know at least two words for dandelion in English. I wonder if the Interscience job gives both?

If you like the sort of joke that goes down well in a speech you should find the house magazine of the 600 Group just the thing—to cohen a phrase.

Economics Primer

The Science of Wealth. By C. F. CARTER. *Edward Arnold.* (14*s*)

At the present time there is probably more realization on the part of the general public than at any time in the past that the British economy is in serious difficulties, despite all the evidence of widespread prosperity. In its simplest terms, the country is living beyond its income and is enjoying prosperity that is not fully earned.

There is probably general agreement that we should improve our earning rather than curtail our expenditure and this means, above all, improving the efficiency of our manufacturing industries so as to be able to compete more effectively in export markets.

Engineers are therefore having to think even more than usual about prices and costs and are expected to understand economic concepts; so the publication of a new textbook of economics at this time is particularly opportune. Professor C. F. Carter in his *Science of Wealth* is writing primarily for undergraduate students, but his book will be a valuable primer to engineers and others in industry who have had no previous acquaintance with formal economic teaching.

The basis and essentials of the subject are presented in simple and lucid language with numerous clear illustrations and an adequate index, and the book can be read straight through. On the other hand, it should be appreciated that in a book of less than 200 pages selling for 14*s* it is impossible to cover more than the rudiments of economics and this book is not for the specialist.

However, there are many in industry who are ignorant even of the rudiments and whose ideas of supply and demand, of the relationship of output to profit, of the Bank Rate and of the Gold Standard are hazy in the extreme. This book will not only give them an idea of what such subjects are about, but will probably encourage them to tackle more weighty books, a list of which is provided by the author.

K. A. LANE

Tunnel to France

Channel Underground. By DERYCK ABEL. *Pall Mall Press.* (17*s* 6*d*)

Europe is integrating, the Common Market, we hope, is on its way, and once more a new Channel Link is a live issue. There is no doubt that a new link with the Continent is very desirable. The prospect of something being done after many years of discussion and argument appears to be better than at any time in the past now that the French Government has taken the initiative and has formally approached the British Government.

There have been many proposals as to the form this link should take, the latest being a cableway and a new bridge design (by a group backed by the Union Routière).

The Study Group which has recently reported decided that a railway tunnel through the lower chalk was both feasible and economical. Looked at as a commercial proposition which has to pay for itself from the tolls it receives, it looks as if a railway rather than a road or railway-cum-road is the answer. If this is accepted, then the ventilation problem is simple and, provided one can be sure of one's ground, the bored tunnel would appear to be the best solution.

Besides being a promising commercial venture, there are many other benefits of a Channel Link which should not be lost sight of. Not all of these are capable of assessment in terms of £'s or francs, but are nevertheless important. In this connection it would be a tremendous advantage to have a road link as well as a railway. If this is conceded, then another look should be taken both at the pre-formed tube idea and the various schemes for bridging the Channel.

It is a pity that proposals for a tube have not been studied in greater detail. It has been said that the Channel weather rules out these schemes, but spud pontoons can work in all but the worst storms. One great advantage of a tube is that the ventilation problem is much easier and makes a roadway feasible.

Bridge schemes have many attractions, the two main drawbacks being the alleged danger to navigation and the cost. If the design were to include four really wide navigation spans, two on each side of the Channel, surely this would overcome the qualms of the navigator. The cost would be high compared to tunnels or tubes but one gets very much more for one's money. There is a far stronger case for subsidizing a Channel Bridge than a replacement of the "Queen Mary."

One other point might be mentioned. If the Hovercraft proves itself a success and is able to go to sea in a gale, then it will be a dangerous rival to a railway tunnel—but far less so to a bridge. Incidentally, a swarm of Hovercraft is likely to be a far greater menace to shipping than a bridge!

Channel Underground is an attempt to present the background and the issues involved to a general reader. Almost half is devoted to history: a very readable, racy account of the fantastic and the not-so-fantastic ideas that have been conjured up since the beginning of the last century. One hundred years ago, de Gamond, with his five different Channel schemes and his enthusiasm for all of them, persuaded Governments and business men that his projects were worth serious consideration. But all these and many other schemes were turned down, mainly because of the opposition of the Army. It seems odd that we have to wait for the atom bomb age before the military strategists are satisfied with the use of tunnels for peaceful purposes.

The remaining chapters are mainly a paraphrase of the 1930, 1960 and subsequent reports, which Mr. Abel accepts without much comment. One cannot but admire the confidence and precision of the experts. Although the 1930 estimates of growth of traffic were stupidly precise and far too cautious, the 1960 figures look suspiciously as though they are repeating the same errors. For example, the growth of accompanied vehicles through the tunnel is predicted as being less than an average of 3 per cent per annum, whereas the Road Research Board in their report for 1960, states that if the present trend continues the growth of vehicles in this country over the next ten years will be at the rate of nearly 9 per cent per annum and over the next 50 years, 6 per cent per annum. The number of cars on the Continent is likely to go up by an even greater percentage, and it seems very pessimistic of the Study Group to suggest that the tunnel traffic will increase so little compared to the new cars on the road.

There is a delightful air of precision about the estimates of cost which, in many instances are given to the nearest £100,000 (e.g. all the tube estimates). This gives the layman a false impression of how near an engineer can estimate. With a project of this magnitude, and with all its unknowns, it would be reasonably good estimating to be within 10 per cent or say £10 million. Then five years is quoted as a conservative estimate for building a tunnel. I wonder! No mention is made of the time for designing, preparation of documents, tendering, negotiating with contractors and so on, which is unlikely to be less than two years and could well be considerably more.

The chapters on the financial and economic aspects do not give a clear picture of the financial

implications and are disjointed and sketchy. It is not clear how much profit is anticipated and no mention is made of the operating costs of any of the schemes, without which it is impossible to compare their merits on a financial basis.

A brief account is given of some of the legal problems involved in constructing a link across the Channel, and this is illustrated by appendices giving the draft Anglo-French Treaty of 1876 and the Mont Blanc Tunnel Convention of 1953 in connection with the road link between France and Italy.

In this book, the general reader will find an interesting brief account of the history of the Tunnel and an account of the Study Group's findings which is a useful piece of reporting. The book, however, would be far more valuable if descriptions of other sound proposals reported in the National and Technical Press were given and an attempt made to discuss and compare them, particularly from the point of view of amenity and cost (both initial and long term operating and maintenance costs).

D. P. BERTLIN

Porsche and His Cars

Porsche: The Man and His Cars. By RICHARD VON FRANKENBERG. *G. T. Foulis and Company, 1-5 Portpool Lane, London EC1.* (30*s*)

Ferdinand Porsche had three ambitions—to make a cheap and marketable small car, to make racing cars and to build tractors. If he had not kept all three at the forefront of his mind he might easily have been side-tracked into specializing in any one of them. For example in 1932 the Russians offered him a contract as "State Designer of Russia" which had untold possibilities for an ambitious and imaginative engineer. But the restrictions it would have put on his liberty (for example inability to leave Russia) decided him against it. So also did his patriotism and unwillingness to leave his own hearth.

Porsche (whose cars came before the British public at an exhibition as late as 1951) had several of the ingredients of his kind in his early career. There was his father who could not see his son's mechanical gifts (early as they blossomed) and the mother who did. There was the sudden break of good fortune which gave him a technical education on a part-time basis in Vienna while he was a student employee at Bela Egger, later to be known as Brown Boveri. From this developed a brilliant engineer of limited commercial capacity (a not unknown limitation in the German motor car industry even today—or in other countries and industries too), an autocrat in an age of autocratic management and a man who did not suffer fools gladly.

The book tells Porsche's story sympathetically and painstakingly. It is a translation and in places reads like it. What may well have been a somewhat heavy style in the original German carries over into English. The humour and the anecdotes blink rather than sparkle. It is difficult to believe however that the author ever wrote in German what appears on page 162: "The 1,500-cc Porsche gave 60 bhp at that time, and for the autumn a 'Super' engine was planned with 70 horses."

Most of the second half of the book is concerned with the recent history of the Porsche company. Dr. Porsche died in 1952. He had accomplished the three goals he set for himself. He had produced the original Volkswagen designs. Others went on to elaborate them.

The book is a useful chronicle of the Porsche contribution to the modern car but it could have been made even more acceptable as a work of reference if it had titled as well as numbered chapters and if the index went to any extent beyond proper names.

G. E. TEWSON

Soil Mechanics is Practical

Introductory Soil Mechanics and Foundations. Edited by GEORGE B. SOWERS and GEORGE F. SOWERS. 2nd Edition. *Macmillan Company, New York and London.* (56*s*)

From Theory to Practice in Soil Mechanics. Selections from the Writings of Karl Terzaghi. *Wiley, New York and London.* (96*s*)

Although the title of the Sowers' book contains the words "soil mechanics," the preface to this second edition uses the expression "soil engineering," and thereby indicates that the subject has passed through the academic stage which so hindered its early general use by civil and structural engineers into the practical experience of most engineers. The authors are a military engineer and a professor, and are clearly well matched to develop the subject for both the student and the practising engineer.

The mathematical side of the book is clearly and adequately expressed and the practical side is very well covered except for one omission. No practical details are given of geotechnical treatments for improving soils *in situ* except for drainage and subgrades. It is when soils are difficult that one turns the quickest to the text books.

Soil mechanics is shown to be the scientific link between geology and foundation design. Teachings have always been that a good geologist was needed to make a good soil mechanic but this book shows that a study of soil mechanics is necessary before a full comprehension of geology can be gained.

The authors give good sections on soil origin, identification and classification which together with the data given on excavation, placement, compaction and slope stability form an invaluable thesis for constructional work with soils in subgrades, embankments and dams.

The general properties of soils and rocks are dealt with and the dividing line between the two at 200 lb per sq. in compression strength is one which will interest contractors in excavation problems. Considerable emphasis is placed on soil structure so that an understanding of the natural behaviour of soils under stress, frost action, weathering and alterations of water content is developed in the reader.

The chapters on settlement and shear strength tests and methods of analysis are adequate for both graduate and professional study. Problem sections are included for those who wish to familiarize themselves with the techniques of handling the test data and computations. A whole chapter is devoted to the evaluations of shallow foundations based upon settlement and shear strength considerations.

Another section is devoted to deep foundations in which piles are dealt with clearly and rationally, but piers and caissons sunk onto rock are not evaluated in terms of the supporting values of various rocks at large depths. It is understandable that underpinning is not dealt with at great length because it is so specialized.

In shallow and deep foundations we are told how to design on clay and on sand but, as in many books on soil mechanics, the engineer is left a little uncertain in the case of the heterogeneous soils which the boring foreman always seems to be encountering and which for fear of being caught out describes as gravelly sandy silty clay with small cobbles.

Earth pressure problems are mainly connected with retaining walls, cofferdams, excavations and anchors. All these are treated together and leave the reader confident of being able to assess the pressures correctly. The importance of permeability and water level is brought out strongly in respect of earth pressure problems and also in connection with dams and drainage.

Landslides are particularly interesting especially when they are on someone else's slopes, and as the number and height of embankments and dams is increasing the value of the analysis given becomes more important each year.

All foundation engineering is dependent on site survey, and the authors have left their description of it to the end of the book, perhaps because it is necessary to know what is needed from the laboratory tests and calculations before a specification for any particular survey can be drawn up. More emphasis could have been placed on the engineer remaining on site during all the survey to get the "feel" of the soil. Also greater details could have been given on the interpretation of the standard penetration test.

Throughout the whole book the foolishness of assuming that what is satisfactory in one field will also be so in the next is well demonstrated and we are left in no doubt that expenditure on a proper survey (detailed in an appendix) is well spent.

That Bjerrum, Casagrande, Peck and Skempton should come together to assemble and record the achievements of one man is proof enough of the value of those achievements.

That the bibliography compiled by the librarians of the Norwegian Geotechnical Institute dates the works of Terzaghi from 1906 to 1960 and enumerates them from 1 to 256 is proof enough of the universal acceptance of those achievements.

Of these works a selection has been made which contains the early classic papers, including studies in strength of soils, settlement, stability, dams and earth pressure. To these are added the presidential address given to the first International Conference on Soil Mechanics and other general reviews of the development of the subject. A biography precedes the papers and thus the reader is favoured with a complete study of the man and his works together.

Terzaghi's life began in Prague in 1883. After graduation in 1904 he joined a contracting company and had opportunity to develop his love of geology. After various assignments he entered the United States in 1912 studying dams. The 1914-19 war saw him back in Europe and between this and the Second World War he spent his time in both Europe and the United States, always pursuing knowledge of foundations, teaching and problem-solving. In the Second World War he settled in Harvard University and has since developed his world-wide consulting practice and become known as the father of soil mechanics.

Two features have made Terzaghi the father of his science: his experience of how soils behave in practice and his realization and utilization of the relation between the stresses in the structure of soil grains and the pressure in the water between the grains. Problems of settlement, bearing capacity, slope stability, and retaining walls are all dependent on this relationship.

The fascination of the science is that no particular site has sufficiently uniform or ascertained characteristics to enable an analytical solution to be relied upon entirely. With this in mind it is easy to see why Terzaghi was "dragged into the consulting fraternity" in the absence of others having both the practical and analytical abilities.

In the presidential address to the first International Congress on Soil Mechanics in 1936 Terzaghi said that he had made an inventory

of technical works since 1850 and had been able to abstract less data on foundation engineering than was contained in the two volumes of the Proceedings of the conference. This state of affairs reveals how fortunate the engineering profession has been in this era of construction to have such a technician just at the time when needed. The collection goes right to the roots.

With respect to clays, the problems of slope stability, earth pressure, friction and shear strength are dealt with. The effect of water pressure, which can or cannot get into the pores is discussed. Surely this is one of the aspects of clay mechanics which when misunderstood has led to more failures than any other cause.

With respect to sands, failures due to piping on the down stream side of dams and weirs are reported, through lack of knowledge and perhaps because the presence of a coarse grained foundation induces the belief that nothing can go wrong. It is shown that the location of the protective method may in fact so concentrate the flow lines and modify the intergranular velocity that the protective method defeats its own purpose.

The early papers also deal with relative densities of sand and their compactabilities.

An interesting paper is included on soils permanently frozen and the effects of placing buildings on them. As we are taking more interest in lands beyond the zero isothermals this paper will soon come into its own in a big way.

The final section of the book—occupying some 100 pages—is a selection of Terzaghi's professional reports. That a report on a client's problem can be re-read years after it is written by a person not acquainted with the problem is a credit to the writer.

In this section are reports on problems on settlement, lateral pressure, soft clay tunnelling, cofferdams, earth dams, stabilization of landslides. These form a very good cross section of the practical application of soil mechanics and thereby justify the title *From Theory to Practice in Soil Mechanics*. They also round off the reader's study of Terzaghi himself.

STEWART CHAMPION

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Construction

Asbestos Ships Board. TURNERS ASBESTOS CEMENT CO. LTD., Trafford Park, Manchester 17. Booklet deals extensively with "Turnall" asbestos ships board as a non-combustible material for the resistance and control of fire on passenger ships and others. Methods of fire protection, installation details, tables and data are provided. 16 pp. ill.

Heavy Fixing Devices and Compounds. EXPANDITE LTD., Chase Road, London NW10. The "Philplug" series is covered, and anchor bolts, stud bolts and Expanda bolts are described, together with the sleeper compound for re-fixing rail screws and spikes in wood and concrete sleepers. Railway inserts are also included. 4 pp. ill.

Air Inlets. ROBERTSON THAIN LIMITED, Ellesmere Port, Wirral, Cheshire. A booklet on a new range of ventilators. The units are available in two standard widths, and ten standard heights. Positive control is provided between the extreme positions. Aerofoil blades ensure tightness when closed. Units may be operated manually, remotely, or electrically, either singly or collectively. 8 pp., ill.

Fan Convectors. COPPERAD LIMITED, Colnbrook, Slough, Bucks. A booklet giving full particulars of applications, sizes, features, specifications, and technical details of the various types of equipment available.

Equipment

Machine Lubrication. C. A. NORGREN LTD., Shipston-on-Stour, Warwickshire. A catalogue of equipment for machine lubrication on the Micro-Fog system. Features of this method are described and particulars are given of equipment sizes and capacities. 15 pp., ill. A design manual on this method of lubrication, describing method of operation, equipment required, and mode of incorporation. 23 pp., ill.

Laboratory Equipment. ENGINEERING LABORATORY EQUIPMENT LTD., 285 Ealing Road, Alperton, Wembley, Middlesex. This catalogue—Publication No. P2122—contains eight sections on equipment used for the testing of soils, concrete, powders, and other materials involved in construction. There are sections on mobile laboratories for use on sites by building and civil engineering contractors and public authorities. An item of interest to those engaged in the construction of roads, airfields, and earth dams is a combined density and moisture surface meter, capable of handling by a single operator, which can determine *in-situ* dry density to an accuracy of 1·5 per cent in less than 5 minutes.

Rotoplunge Pumps. PARKINSON COWAN MEASUREMENT, PO Box 2, Dobcross, Oldham, Lancs. This brochure outlines the construction of Rotoplunge pumps and gives specimen applications. Outputs are from 7·5 to 2,300 gal per hour. A section describes the Shoflo sight-flow indicator. 12 pp., ill.

Signalling. WESTINGHOUSE BRAKE AND SIGNAL CO. LTD., 82 York Way, London N1. A brochure on signalling for South Africa. Describes installations carried out for the South African Railways, Rhodesia Railways, East African Railways and Harbours, and a Rand mine. Automatic electrically-operated road barriers are also referred to 16 pp., ill.

New Books

Electronic Maintainability. Volume 3. Edited by F. L. ANKENBRANDT. *Engineering Publishers, Elizabeth, New Jersey. Distributed by Reinhold, New York; Chapman and Hall, London.* (80*s*)

Proceedings of the Third Electronic Industries Association Conference on Maintainability of Electronic Equipment, San Antonio, Texas. The subject matter ranges from the maintenance problems of space flight to the determination of adequate working space for electronic technicians.

High Voltage Distribution Practice. Edited by J. H. GRIDLEY. *Benn.* (45*s*)

The greater part of the book is based on a symposium held at the Regent Street Polytechnic, at which 8 UK experts described various aspects of distribution work, with special reference to the achieving of optimum balance between cost and effectiveness.

Mechanical-Electrical Equipment Handbook for School Buildings. By HARRY TERRY. *Wiley, New York and London.* (76*s*)

American practice in the installation, maintenance, and operation of heating and ventilating plant, plumbing, sewage disposal, kitchen and cafeteria equipment, and lighting and wiring.

Strength of Materials. By G. H. RYDER. 3rd Edition. *Cleaver-Hume Press.* (24*s*)

Changes in the present edition of this widely-used textbook for HNC and degree students comprise several improvements in detail, further consideration of temperature stresses and plastic collapse loads (with special reference to beams, cylinders and rotating discs), and the addition of recent examination problems to several of the chapters.

Mechanical Behavior of Materials at Elevated Temperatures. Edited by JOHN E. DORN. *McGraw-Hill, New York and London.* (£5 12*s* 6*d*)

Fifteen specialist contributions have been welded together to give a systematic account of dislocation theory and its application in describing the mechanism of creep and related high temperature phenomena.

Toughness and Brittleness in Metals. *Published for the Institution of Metallurgists by Iliffe.* (27*s* 6*d*)

The four papers contained in this volume are the lectures delivered at the 1960 Refresher Course of the Institution: The definition and significance of toughness and brittleness in metals; Engineering aspects of toughness and brittleness in metals; The effect of environment on embrittlement in metals; Metallurgical aspects of ductility and brittleness in metals and alloys.

Technical Data on Fuel. Edited by H. M. SPIERS. 6th Edition. *British National Committee, World Power Conference, 201 Grand Buildings, London WC2.* (60*s*)

Recognized experts in various branches of the fuel and power industries collaborated in the preparation of this invaluable compendium, which has been extensively revised (several sections have been completely rewritten and, where necessary, tables have been recalculated or replaced on the basis of more recent and reliable data). Of the new topics in this edition, mention may be made of the viscosity blending of oils, flow in fluidized systems, and nuclear fuels.

Water Treatment for Industrial and Other Uses. By ESKEL NORDELL. 2nd Edition. *Reinhold, New York; Chapman and Hall, London.* (96*s*)

Much new material has been incorporated and several changes have been made to bring this authoritative and comprehensive reference work and textbook up-to-date.

The Reviewers

Mr. K. A. Lane, M.A. (Cantab.) is a physicist by training, but has for some years been concerned with personnel and general management. For the past five years he has been personal assistant to the managing director of the English Electric Company.

Mr. D. P. Bertlin, M.Eng., is senior partner in a firm of consulting engineers. He has had considerable experience of both construction and design of tunnels, bridges, hydroelectric schemes, dock engineering and prestressed concrete work. He is an M.I.C.E., M.Cons.E. and an M.Soc.C.E. of France.

Mr. G. E. Tewson, M.A., is a partner in the firm of O. W. Roskill, Industrial Consultants.

Dr. Stewart Champion, M.Sc.(Eng.), Ph.D., is geotechnical engineer with Foundation Engineering Limited. He is a member of the Institution of Civil Engineers and also of the Institution of Structural Engineers.

Industrial Water Treatment Practice. Edited by P. HAMER, J. JACKSON and E. F. THURSTON. *Published by Butterworths in association with Imperial Chemical Industries Limited.* (95*s*)

This comprehensive handbook is concerned solely with the treatment of water for use as the raw material for steam generation and as cooling water.

Evaporative Cooling of Circulating Water. By L. D. BERGMAN. *Pergamon Press.* (£7)

Translated from the 2nd Russian edition (1956), this is a systematic account of the theory, design and applications of evaporative coolers. The material is organized within six main sections: Heat and mass transfer in evaporative cooling; Theory of coolers; Problems of hydraulics and air distribution in coolers; Types and designs of coolers; The thermal design of coolers; Operation of coolers.

Proceedings of the International Symposium on Distillation, Brighton, May, 1960. *Institution of Chemical Engineers, 16 Belgrave Square, London SW1.* (80*s*)

The 28 papers were delivered in 6 sessions, covering the following broad subject areas: Heat and mass transfer; Vapour-liquid equilibria; Performance of packed columns; Performance of trays and other columns. Each session was followed by a discussion.

Design and Construction of Foundations. By G. P. MANNING. *Concrete Publications Limited, 14 Dartmouth Street, London, SW1.* (24*s*)

Suitable for students as well as established civil engineers, the book is intended for use in everyday design and construction work that would normally be undertaken in general practice without the advice of foundation experts. Most of the designs apply to land sites (dry or waterlogged), but there is a chapter on submerged sites.

Servicing Guide to British Motor Vehicles. By M. H. ROSEWARNE. Volume 6: Cars, Commercial Vehicles, Diesel Engines and Components. *Iliffe.* (75*s*)

Compiled from Service Data Sheets published in *Motor Trader* over the past two years. Eighteen cars, two commercial vehicles, two diesel engines and eleven components (including the Borg-Warner automatic transmission) are featured. Conversion factors, tables of US, British and Continental units, and a list of *Trader* sheets for prewar models are appended.

Marketing

The BEAMA Jubilee Conference

With its theme of trading abroad, the first day of the British Electrical and Allied Manufacturers Association's annual conference provided ample scope for some lively discussion. BEAMA celebrated their golden jubilee on 5 October.

Four talks comprised the day's proceedings: "The Electrical and Allied Industry in the Export Field," by Mr. Anthony M. Browne, President of the association; "Engineering Achievements in the Electrical Industry," by Mr. F. H. S. Brown, vice-chairman of the CEGB; "Exporting to Europe," by Sir William McFadzean, chairman and managing director of British Insulated Callender's Cables Limited and also chairman of the Export Council for Europe; and "Exporting to the Western Hemisphere," by Mr. W. J. M. Longmore, managing director of Balfour Williamson and Company Limited and leader of the Latin American division of the Western Hemisphere Export Council. Mr. L. H. Short, Chairman of the BEAMA Export Panel and Director of Overseas Operations with the English Electric Company, was in the chair.

During lunch the delegates were addressed by Mr. Reginald Maudling, then President of the Board of Trade, who in a tribute to the vigorous efforts and achievements of the industry, said that its exports were running at a level of some £300 million a year, which was a substantial proportion of Britain's total export trade. About 60 per cent of this went to Commonwealth countries. However, Mr. Maudling, striking a more sombre note, went on to say that the growth of business transacted by our competitors compared with our constant level did in effect constitute a decline, one which though expected could and must be arrested by determined sales effort.

As for Europe, Sir William McFadzean, in his lively speech, revealed a success story in that British exports to the 19 countries, which together with the UK formed the old OEEC, totalled £870 million for the first eight months of this year—an increase of more than 14 per cent compared with the same period in 1960. He went on to list pointers to successful exporting, stressing especially, the encouragement that should be given to foreign excursions by top executives and reciprocal visits by carefully chosen trade missions. Most of all, he said, we must overcome our natural reticence and make every effort to publicize our achievements.

Mr. Longmore, while clearly underlining the difficulties, spoke of the expanding possibilities of the South American export market. The market as a whole, comprising 20 separate republics, was certain to constitute in the long run one of the most rapidly developing and high consuming areas of the world. The population of 200 million had the fastest rate of increase in the world—2½ per cent per annum.

Mr. Anthony Browne spoke of the importance of sound economic planning, pointing out the dangers of endeavouring to exist in "splendid isolation" and stressing the necessity for industry and Government to plan together to agree the targets necessary to achieve the rate of economic growth which the country needs.

On the second day of the conference the 300 delegates were divided up into four discussion groups, dealing with topics associated with the theme of the conference.

Egyptian Power Station Contract for English Electric

THE ENGLISH ELECTRIC COMPANY LIMITED have received a £6 million contract from the Cairo Electricity and Gas Administration to build a 120 MW extension to the Cairo South power station. The specification covers the supply of boilers, turbo-alternators and auxiliary equipment. The order, one of the most comprehensive contracts fulfilled by British industry in the area since 1957, will make the power station when completed one of the largest in the Middle East. The bill will be paid partly in kind, arrangements having been made in conjunction with LOUIS DREYFUS AND COMPANY LIMITED to supply cotton in exchange.

The Anglo-Egyptian enterprise, MISR CONCRETE of Cairo, will collaborate with English Electric in the project and have been awarded a £750,000 contract for the civil engineering work. The plant is scheduled to commence operation early in 1964.

The manufacture of the equipment will be undertaken by plants distributed throughout the Midlands: the two main steam turbines, of 60 MW capacity each, will be made at Rugby. Alternators, transformers (including two rated at 75 MVA) and the 63,000 volt switchgear will come from Stafford, the low voltage switchgear and fusegear from Liverpool and the four boilers, each of 441,000 lb per hour capacity, will be made at the Stockport works of SIMON-CARVES LIMITED.

Computer to Aid Quantity Surveying

About three years ago a well known firm of quantity surveyors commenced a study to explore the possibility of utilizing the services of an electronic computer in processing the vast amount of data involved in the planning of a modern building project. Two years later their work came to fruition when an offshoot of the firm relinquished professional status to form COMPUTAQUANTS LIMITED, a commercial undertaking which, after a further year's research, has just been launched at the Electronic Computers exhibition a service aimed at relieving the quantity surveyor of most of the menial tasks. Speed is a salient feature, and it is said to be capable of processing the data for a £200,000 office block comprising more than 1,000 columns of dimensions in less than two hours.

The firm under its managing director, Mr. John MacDonald, employs at present about a dozen people and works in close collaboration with the service centre of Ferranti Limited, whose Pegasus machine is used for the computations.

With the introduction of computers to an ever-widening field of application, there appears to be much logic behind a service such as this for quantity surveyors who are, in the main, small concerns prevented by the vast cost from owning such sophisticated equipment. Computaquants' aim is to enable them to obtain all the benefits of office mechanization afforded to other branches of industry and commerce. In return for their services, the firm receives a fee and out of this pays for the computer facilities in the usual way. The technique employed departs from the traditional practices as little as possible and a library of standard programmes or "standard Bill" has been completed. This is essential to the economic utilization of the computer in the service which covers the full procedure from the end of taking-off up to and including final printing of the Bill. Magnetic tape is the storage medium of this library which contains nearly 20,000 skeleton descriptions 4,000 skeleton headings and a maximum of 676 variable phrases to each trade. These have been prepared on the basis of the standard method of measurement.

It has been said that expansion of the building trade with its associated developments has increased the problems facing the quantity surveyor who is called upon to deal with greater complexities in less time, as modern techniques speed the construction period. The situation is aggravated by a shortage of experienced staff especially in the task of working-up. The computer would appear to offer a solution by overcoming the bottlenecks with a high standard of accuracy while at the same time adhering to the established procedures.

Natural Gas in Yugoslavia

A subsidiary company of BABCOCK AND WILCOX LIMITED, EDWIN DANKS AND COMPANY (OLDBURY) LIMITED, is to work in collaboration with two well-known American design organizations on a contract for Yugoslavia.

The order covers the supply of a petroleum plant and associated well-head equipment to Technometal Export-Import, the agency acting on behalf of the NAFTAGAS concern. The value of the contract is in excess of £1 million.

Yugoslavia possesses extensive resources of petroleum and natural gas and the equipment supplied will be used in the construction of a plant to obtain and process the crude materials.

Export Agents Appointed

In order to assist in the handling of the increasing volume of freight passing between Great Britain and Northern Europe, the TRANSPORT FERRY SERVICE has appointed three new agents. The agents appointed will be based in Western Germany and are Fisser and v. Doornum of Hamburg, Hans-Joachim Leue of Frankfurt-am-Main and Hugo Stinnes of Munich.

Announcing the appointment, Mr. Michael K. Bustard, newly-appointed general manager of the service said: "Lorries and trailers using our roll-on/roll-off service between Tilbury and Antwerp/Rotterdam have greatly increased over the last 12 months. The most striking increase in trade between the United Kingdom and West Germany has been in the field of machinery and machine tools. The special equipment field presently operated by international road hauliers using the Transport Ferry Service is specially designed to carry this traffic."

French Oil Company to Market in Britain

However frustrating it may be for the motorist to see cars coming on to the roads in ever-increasing numbers, the oil companies view it only in terms of greater revenue; the result has been that roadside filling stations have mushroomed almost overnight to cope with the greatly increased demand for petrol.

During the last year a new name has appeared on pumps in England; that of TOTAL, the brand name of the Compagnie Francaise des Petroles Group who after occupying a position of prominence on the Continent since 1924, have set up a marketing subsidiary company called TOTAL OIL PRODUCTS (GB) LIMITED to build up a marketing network in this country.

The group has been active in the comparative obscurity of the commercial field here since 1955 but in 1960 it was decided to enter the retail market and on 1 December the first roadside filling station was opened at Bushy Heath. This was followed 12 days later by another at Salford, Manchester. Since then expansion has been rapid and there are in operation now about sixty such stations, nearly all of which are exclusive to Total.

So far emphasis has been placed on the London and Manchester areas, as the two off-loading ports for the products, which are shipped from le Havre in the refined state, are Canvey Island in the Thames estuary, and Stanlow on the Manchester ship canal. It is intended eventually to extend developments from these two points to cover the entire country and already there are stations in the Midlands.

The company's aim is to provide more than just a refuelling service and the Zidpark, built by MYTON near Southwark Bridge, London, has eleven pumps, dispensing three grades of petrol, full servicing and lubrication facilities, and a multi-storey car park for 500 cars. The new Total station in Brompton Road incorporates Britain's first five minute car wash, reputedly one of the most comprehensive services in Europe. Here, is exemplified the company's policy, that in a highly competitive market, service is all important and the motorist may, in addition to other facilities, obtain a free cup of coffee while he awaits the return of his car.

An even bigger undertaking is in the course of construction at Leicester where MULTIDEK CAR PARK DEVELOPMENTS are erecting what is virtually a community centre, offering in addition to the usual parking and servicing facilities, a wide range of personal amenities including a restaurant, supermarket, hairdressing and a bowling alley.

The crude product is derived chiefly from the Middle East where the company holds almost a quarter share in the Iraq Petroleum Company, which yielded 12½ million metric tons in 1960. In addition, it has a 6 per cent share in the Iranian Consortium which produced nearly 3 million tons and the recently discovered Hassi-Messaoud oilfield in the Sahara exploited jointly with the Societe Nationale de Recherches et d'Exploitation de Petroles en Algerie, from which the company obtained 3½ million metric tons in 1960.

XUM

The Leyland Comet Goods Truck

The story of a company which radically changed its outlook to become one of the leading exporters of British equipment—and of the product around which the revised philosophy was created.

THE Leyland Comet is a product that, literally, never stands still. It is a tool by which its owner/operator makes his living—the higher its availability in traffic, the higher his earning capacity.

But to be a success a heavy goods vehicle must possess capabilities far beyond simply conveying x tons of load from place A to B swiftly and economically. It must also satisfy a conflicting set of man-made physical limitations. For a lorry is dogged by restrictive legislation as to speed, width and gross weight, the severity of which varies from country to country. British requirements are so onerous that it is almost a wonder that engineering technology can provide a practicable heavy commercial vehicle at all—a state of affairs that tends to be masked by the multiplicity of different types on the roads of this country today.

For sixty years Leyland Motors Limited have been pre-eminent in the field of heavy goods and passenger vehicles. Their distinguished career in this field might almost be described as a long fight against acute restrictions. As soon as self-propelled road vehicles started to appear during the nineteenth century, every effort was made by legislation and taxation to drive them off the roads, and in fact by 1865 practically every such vehicle had been forced into retirement. Leyland's first of a long run of triumphs against almost impossible odds was their "steamer," introduced by their predecessors, the Lancashire Steam Motor Company, as a 30 cwt steam van in 1896, and which continued in production for thirty years. They were also early in the field with the internal combustion engine.

With such heavy restrictive legislation in this country, there must be a certain incentive to design vehicles solely for the less exacting overseas market. In practice, no company could hope to establish a healthy export business for any product for which it could not treat the home market as a shop window. When the Comet was introduced in 1948 it fitted in admirably with the "Export or Die" slogan we became so used to hearing after the war—but it still had to comply with this country's requirements and today some 40 per cent of Comets go to the home market.

British legislation classifies commercial vehicles in terms of gross weight, and stipulates the minimum number of road wheels. The maximum permitted speed is related to the vehicle's registered unladen weight. Luckily for the Comet, the maximum registered weight of a vehicle permitted to travel at 30 mph was raised in 1941 from 2½ to 3 tons, while heavier vehicles were still restricted to a maximum of 20 mph. In 1960 the limit for vehicles exceeding 3 tons was also raised to 30 mph, with the exception of those carrying abnormally large loads for which separate legislation exists. Negotiations are currently in progress on the question of raising the limit for passenger coaches to 40 mph, as it is common knowledge that they constantly break the law by speeding; yet at the stipulated 30 mph they tend to create obstruction.

Fig. 1 Early Comet at work in Rhodesia.

Since gross weight = registered weight plus maximum payload, the successful designer is the one who can safely pare the weight of his vehicle to the absolute minimum in order to offer the best load factor. Leyland have always tended to concentrate on commercial vehicles in the heaviest class, using every means in their power to keep down the registered weight.

Oddly enough, the Comet truck is the result of a breakaway from the heavy to the medium capacity truck which Leyland made in the mid-1930's when they introduced the famous Cub. In the later Cub models the maximum registered weight of 2½ tons was taken as the criterion in order to bring it within the 30 mph class. It was followed in 1937–38 by the Lynx with a loading of 8¾ tons. There was naturally a big incentive to manufacturers to bring the registered weight below 2½ tons, and the Cub and Lynx were Leyland's first sally into the lighter vehicle market. They proved to be a great success, but their development was halted by the War.

During the period of hostilities the only vehicles Leyland were permitted to turn out were tracked vehicles, mainly tanks, including the Centaur, the Cromwell, and finally the speedy Comet which came on the scene just in time to join the Allies in their occupation of Europe. With the return of peace, Leyland set out to design a completely new range of vehicles and engines, taking full advantage of the necessity to re-tool. But the new range was to contain a new flavour. Instead of being intended primarily for the home market with the surplus going overseas, designs in future were to be undertaken with an eye to exporting. One of Sir Henry Spurrier's first actions on taking over control of the company was to send his export development manager on a 40,000-mile world tour to make an assessment of overseas transport requirements.

The Comet, which took its name from the tank, formed the spearhead of the export drive, the official announcement containing the following statement, "A range of models basically similar in design will be available for the home market as and when economic conditions permit." Indeed for more than a year the Comet was only made for export. It was introduced with a 75 hp 6-cylinder diesel engine, semi-forward control, 5-speed gearbox and a hypoid bevel rear axle. It represented the postwar version of the 30 mph Lynx and Cub, taking full advantage of the extra half ton now permissible on the registered weight with a future eye on the home market. The first Comet had a 5 to 7 ton payload and, like its predecessors, was offered in several forms including a freight, dump or tractor chassis, soon followed by a 32-35 seater passenger chassis.

UP TO DATE

The difficulty of keeping the Comet within the 3-ton registered weight allowance proved almost insurmountable. Leyland used always to err on the conservative side, but now the only course open to Stanley Markland, the designer, was to swing more towards lightness and then find the weak spots by exhaustive prototype testing and service experience, strengthening locally where necessary. Such a procedure poses a vital question—should the designer take a chance that the weight will still come out on the good side, or should he increase the cost of the vehicle by introducing light alloy? The Comet did not resort to light alloy and the result is a robust vehicle with the minimum of wasted material.

From the first Comet a steady succession of modifications and improvements to meet current requirements have resulted in a Comet range that is as up to date today as it was in 1948.

Among the first steps were the introduction of a 2-speed rear axle (giving, in effect, 10 speeds), and discontinuance of the petrol version of the Comet's diesel engine. In 1949 the Motor Industry Research Association opened its test

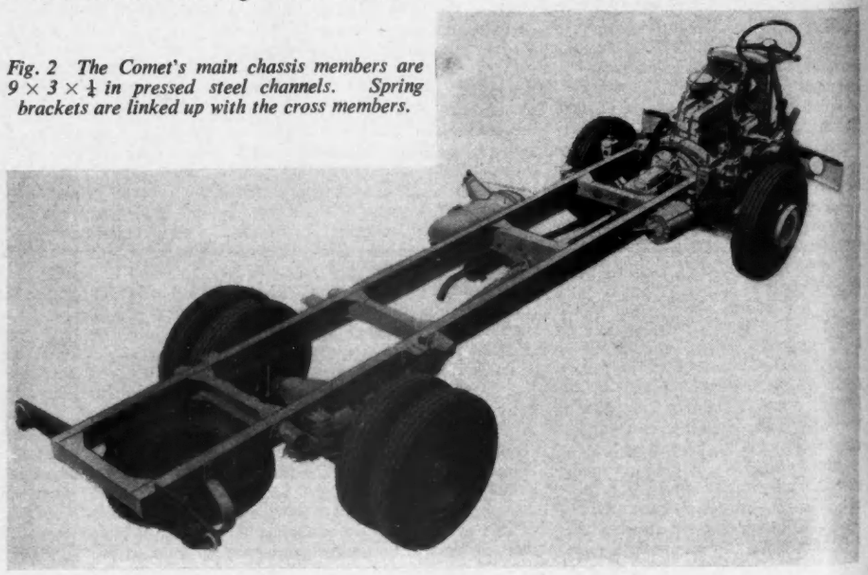


Fig. 2 The Comet's main chassis members are 9 × 3 × ¼ in pressed steel channels. Spring brackets are linked up with the cross members.

Fig. 3 Never be afraid to make improvements to meet changing conditions.

Fig. 4 Cab comfort and convenience.

track at Nuneaton which included a ½ mile stretch of Belgian "pavé." The Comet was one of the first vehicles to be tested and covered many miles over the pavé without serious incident; but the experience led to more strengthening here and there, particularly in the pressed steel cab. Such testing reinforced one of the Comet's two main selling points, robustness. The second is economy in both fuel and maintenance due to advanced engine design and even the early Comets would run 250,000 miles without major overhaul.

In 1951 research on the MIRA test track again bore fruit with the début of the Comet 90, in which the engine was uprated to 90 hp and the carrying capacity increased by 2 tons up to the maximum gross rating on four wheels of 12 tons. The 90 incorporated the internationally recognized chassis frame width of 34 in, permitting standardization among the bodies produced by different body manufacturers. It is normal practice for the commercial vehicle manufacturer to supply the chassis, engine, transmission, wheels and cab, leaving the body to be built and fitted separately. A left hand drive version was introduced later the same year.

In 1953 the hypoid bevel rear axle was altered to a spiral bevel to eliminate the need for a special grade of oil, not always conscientiously applied, particularly overseas. A year later a heavier type of 5-speed gearbox was "borrowed" from Albion (who had been taken over by Leyland in 1951). It was henceforth fitted as standard in the Comet, giving an optional high or low speed power take-off for tippers and truck mixers. A full forward control driver's cab was also introduced to Comet trucks in 1954, made of stressed light metal in separate jigged panels—very useful for the growing trend towards CKD (completely knocked down) shipment overseas.

In 1955 the engine was uprated to 100 hp with better torque and speed characteristics in order to maintain its minimum fuel consumption over a wider speed range. The piston crowns remained toroidal in shape in combination with a "squish" shaped combustion chamber.

In 1958 Leyland introduced the Super Comet, in which the gross weight was raised to 14 tons to take advantage of a recent legislative change. Since then both the Comet and Super Comet ranges have been produced in parallel with the former predominating numerically. In the Super Comet a still larger engine of 110 hp was fitted. The braking was improved commensurate with the greater carrying capacity, a direct air pressure system taking the place of the vacuum servo assisted brakes of the Comet. More robustness was given to the vehicle, and an ingenious 3 to 1 hub reduction rear axle affording lighter stressing of the axle shafts due to their taking only one third of the torque.

In some quarters Leyland were accused of hitting at their own heavy goods range by continual enlargement and widening of their range of medium trucks. Subsequent experience has disproved this argument, and their remarkable success overseas, where they have markets in over 80 countries, owes much to the wide range of vehicles in the Comet and Super Comet classes.

The final stage in the evolution of the present Comet truck that ENGINEERING's representative witnessed coming off the production line, is increasing rationalization between the Comet and Super Comet by extending to the former some of the latter's special features, notably the hub reduction axle and Super Comet's "vista vue" cab. This cab is not just a gimmick—it has been specially designed around the latest forward control concept to give the driver better all-round vision, comfort (and hence safety), and more weight-saving by using unstressed skin construction with a rigid sub frame.

The Comet's vacuum-assisted servo braking has given way to a Hydrovac system, and within the last year both trucks have received engines from the new Leyland "Power Plus" range. The Comet's engine develops 110 hp and the Super Comet's 125 hp; thus Leyland have made another step forward in engine power without increasing the overall envelope size or cylinder bore. The Power Plus engines have a crossflow head with the exhaust and inlet on opposite sides, and the toroidal shape of the piston crown has given way to spheroidal.

The logical outcome of continual modification of both Comets to meet the latest requirements of the overall market might appear to lie in complete unification, but a reasoned policy of broadening the variety of medium trucks in order to get a wider hold on the market is most unlikely to be reversed in the foreseeable future.

Sir Henry Spurrier, Leyland's Chairman, is the driving force from whom springs the wisdom of good management and good human relationship at all levels in the organization. Sir Henry is also a gifted engineer, and no technical change of any kind is made to any vehicles or engines in the Leyland range without his full knowledge and consent.

ORGANIZATION GROWS

The size of the Leyland organization has increased enormously, especially since the war. The four factories in the district around the town of Leyland in Lancashire (pop 18,000) employ around 11,000 at present, and the Leyland group's annual turnover, including Albion and Scammell but without Standard-Triumph, has reached over £60 m.—good money by any standard. India, always one of the best overseas Comet markets, now boasts a factory of her own which will soon be producing Comets at the rate of 6,000 per year.

It is tempting to try to compare the commercial vehicle and the private car industries, especially as Leyland now have a foot in both camps. While the design problems have a certain similarity the marketing aspects are totally different. Mass production in the volume generally accepted by the car industry is quite impossible with commercials, each of which represents a heavy capital investment. Leyland build only to order and at the moment they have a successful order book.

Servicing facilities are treated with great importance and it could be said that Sir Henry's firm insistence on providing adequate service facilities before breaking into a new market has pointed the way for both cars and commercials alike. The story is told of Sir Henry refusing an order for 200 buses due to having no service facilities in the area at the time. One thing is certain; if the Comet tank did not conquer the world, then at least the Comet truck has done so.

Leyland Motors Limited, Leyland, Lancs.

Fig. 6 (right) The Comet's Power-Plus 0·370 diesel engine delivers a net installed output of 110 bhp at 2,400 rpm.

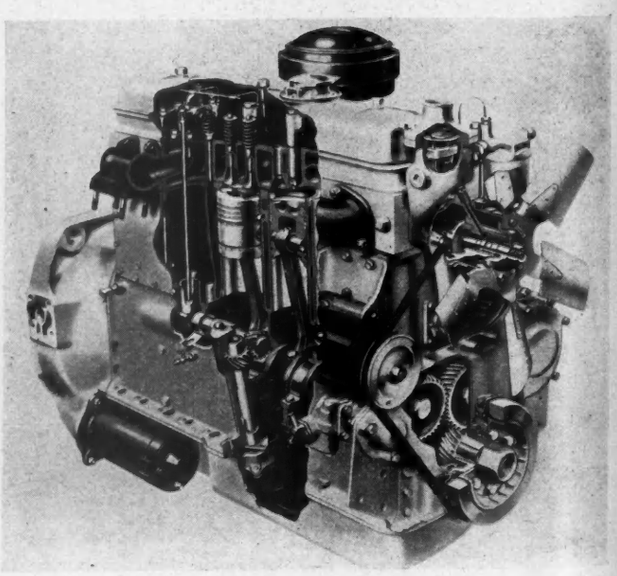
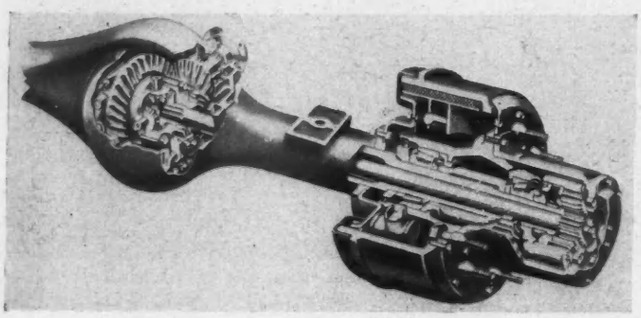


Fig. 5 (below) The Comet hub reduction rear axle.



Electronic Thawing for Frozen Fish

After several years of research, both independently and in association with the Torry Research Station of DSIR, Birds Eye Foods Limited have now installed at their Lowestoft factory electronic apparatus which will thaw whole blocks of herring very much more rapidly than conventional methods. Approximately 1½ tons of fish can be brought up in one hour from —20° F to just below 32° F, with each slab of solid frozen herring taking just about 15 minutes to pass along the belt through the oscillating electric field.

The fish is packed under strictly controlled, hygienic conditions and to preserve the desired freshness and flavour of the product while thawing, heat must be applied evenly throughout until the flesh reaches a temperature at which processing—filleting, skinning, etc.—can be carried out. This desired temperature is just below the normal freezing point of water.

When ordinary methods are used only the surface of the food can be thawed satisfactorily but, by using a new dielectric method, the food thaws evenly throughout. This is done by placing it in a rapidly oscillating electric field, the frequency of oscillation ranging up to about 40 Mc/s.

Dielectric heating has been used in engineering industries for many years, but few food companies have used it until now. As Birds Eye's output of frozen fish increased, however, efforts to solve earlier problems were redoubled. As well as working on the problem independently, Birds Eye have been in close touch with scientists at the Torry Research Station, Aberdeen.

The basic equipment for thawing fish is now available to the food industry in general, but Birds Eye have incorporated features which are said to improve its operation. Most of the initial tests were carried out at about 40 Mc/s, but it was decided to operate at 27·12 Mc/s to avoid interfering with radio and television reception. Although a risk was taken that food might not thaw so well at the new frequency, it proved satisfactory.

A second design feature which was considered to be very important concerned the cleaning of the equipment. The fish is carried through the electric field on a belt which can be readily withdrawn from the apparatus to facilitate regular thorough cleaning. The belt is continuously cleansed during its return cycle by brushes and by immersion in fresh running water.

The plant contains 8 self-oscillating water-cooled generators, each with a power output of 12 kW at 27·12 Mc/s. The total power input to the plant is about 200 kW, the fish consuming about half of this. Each generator supplies energy to its own pair of electrodes, the fish being carried on a food grade rubber belt between the pairs of electrodes in series. The power is matched in by means of a coupling coil and transmission line into a tuned circuit consisting of a condenser (the fish sandwiched between two electrodes) and a variable inductance. The electrode spacing can be varied from 2 in to 4 in to enable the thawing of thick slabs of fish.

Ceramics Found Suitable for MHD Power

Using ceramic containers, research engineers of the Westinghouse Electric Corporation, New York, USA, have succeeded in operating an experimental magnetohydrodynamic generator for periods of time up to 50 minutes. Previously, a normal operating time for such generators has been a few seconds.

In magnetohydrodynamic (MHD) generators, a moving stream of ionized conducting gas, called a plasma, as hot as 5,000° F and with speeds up to 2,000 miles per hour, replaces the copper conductors of the conventional generator. The key problem to be solved in order to achieve practical MHD power generation is finding materials that will stand up to the temperature and speed of the moving plasma. Most materials melt, burn, oxidize or crack from the heat shock, or erode away in the rushing gas.

The ceramics studied by the Westinghouse research team are the first that have been reported to withstand such conditions for appreciable periods. They cannot be said to have solved the problem of achieving practical, large-scale MHD power generation, but they do represent an initial step forward in developing materials that may eventually make MHD power feasible.

Three Westinghouse research engineers, Mr. W. E. Blodgett, Mr. T. M. Harkulich and Dr. W. E. Young, have been engaged on the study of ceramics as container and electrode materials. Performance tests on these materials have been carried out on an experimental 10 kW MHD generator.

Because they generally possess high melting point, hardness and chemical inertness, ceramics are good candidates for MHD operation. Such a generator requires two basic types of refractory materials; (1) an electrical insulating material for lining the walls of the generator, and (2) an electrical conducting material for the electrodes which carry away the electric current.

The insulating materials are needed to protect the walls from the hot gases and to keep the electrodes, which are located in the walls, from short-circuiting. These materials must retain their properties at extremely high temperatures, even though conditions can be relieved somewhat by water-cooling of the generator's container. The environment of the electrodes is even more severe. They are subject to the full heat and blast of the gas stream and cannot be water cooled. This makes the problem of the electrode materials much more critical.

Among the insulating ceramics tested at the Westinghouse Laboratory, magnesia (magnesium oxide) is said to have performed well as a lining material. It did not react, did not lose its insulating properties at high temperature and withstood the erosion effects of the gas stream. Another ceramic, zirconium oxide, showed good endurance. Other materials, including zirconium silicate and beryllium oxide, were found to be less satisfactory.

Among electrode materials, refractory metals such as tungsten, tantalum and zirconium were evaluated, together with certain of their alloys and compounds. Most of the materials showed a tendency to oxidize or melt before the generator's ceramic walls were seriously affected. Graphite, which proved to have excellent electrical conductivity and resistance to high temperatures and thermal shock, had the serious drawback of eroding rapidly in the presence of the fast-moving plasma.

Circuit Breaker for Extra-High Voltages

With world electricity power consumption doubling every decade, power is being transmitted and distributed at increasingly high voltages. In four years from now, Britain's supergrid will be uprated from 275,000 volts to 400,000 volts.

Foreseeing these developments some years ago, the English Electric Company laid down a performance specification for an entirely new range of air-blast circuit breakers which would be suitable for operation between 132 kV and 650 kV, with current ratings from 2,000 A to 4,000 A, short circuit ratings up to 60 kA and very short total break times. These specifications have now been met by the development of the "Frame r" air-blast circuit breaker.

One of many interesting features of the new circuit breaker is the contact pressurization, which gives full pressure both in the open and closed positions. This means that there is no pressure drop or time delay in filling support insulators, such as occurs with breakers having blast valves located at the receiver.

The mechanism ensures very short opening times and the combined effect is a guaranteed 2½ cycle operation at any voltage with extremely good interrupting performance, which is particularly noticeable on line charging and capacity currents.

Since the contacts are pressurized in the open position, it has been possible to dispense with the make switch. This minimizes air consumption and eliminates external moving parts.

Interrupters can be arranged either in "Y" formation (four interrupters per support column) or in "T" formation (two interrupters per column) or in combination of both.

The present methods of proving extra-high voltage multi-gap circuit breakers are based on unit testing of at least one interrupter at 100 per cent of its share of voltage and at full short circuit current. The output of the plant can therefore be decisive in dictating the number of interrupters needed to be employed in a large breaker.

To prove satisfactorily breakers ratings up to 50,000 MVA at 500 kV and above, and at the same time to keep the number of interrupters to the required minimum, English Electric engineers have found it necessary to increase the capacity of their test plant at the Nelson High Power Laboratory, Stafford.

The existing plant consists of two 3,000 rpm alternators with associated transformers and ancillary equipment. To increase this capacity two new alternators are being installed, together with associated transformer banks and full ancillary equipment, with the ability to test at voltages up to 600 kV.

A single building, forming the bar of a T formation with the existing hall, houses both new machines and ancillaries, transformer banks being contained in outside areas at either end of the building. Conducting paths have been kept short by roof mounted bus runs, linking both outputs to overhead lines and ingoing feeders to the test areas.

There are several new features in the plant design. These include the provision of a servo control for the synchronization of four machines and the installation throughout of pressure immersed make-switches; each switch having a making capacity of 300 kA peak.

Where possible, up-to-date insulating methods and materials have been employed, an example being the encapsulation of reactor coils in synthetic resins. Plant protection has been increased by the use of air-blast back-up breakers.

The provision of extra plant has more than doubled the output of the existing equipment, which was itself doubled in 1947. It is thought that, if the present trends are maintained, then some form of synthetic testing may be the only practical way of assessing circuit breaker performance in the future.

New Approach to Thermal Fatigue Testing

By P. G. Forrest, B.Sc.(Eng.), Ph.D., A.M.I.Mech.E. and A. B. Penfold, A.M.I.Mech.E., A.M.I.E.D.

The thermal fatigue resistance of metals is usually measured under the dynamic conditions of specific modes of operation. A research team at the National Physical Laboratory has now devised an apparatus capable of carrying out more basic investigations on the relationships between strain, temperature and endurance.

THERE has been a growing recognition during recent years that many service failures of metals at high temperatures are caused by thermal fatigue, that is, by repeated stresses induced by changes in temperature. The stresses may be caused by the prevention of free expansion by external constraint or by steady thermal gradients, but failures are most likely to result from transient thermal gradients produced by rapid heating or cooling.

Investigations of thermal fatigue have usually been made on components or specially-shaped specimens by simulating the rapid heating and cooling conditions occurring in service[1,2]. Such tests are a useful means of comparing the behaviour of different metals under particular operating conditions, but it was felt that a laboratory test in which the strain and the temperature of a specimen could be independently controlled and measured would be more useful for investigating the factors that influence thermal fatigue resistance and would provide results with a more general application.

The resistance of a metal to thermal fatigue is dependent on three properties, its thermal conductivity k, its coefficient of thermal expansion α and its resistance to the alternating strains produced by the changes in temperature. A high value of k is usually beneficial because it reduces the temperature gradients, while a low value of α is desirable to reduce the strains induced. As values of k and α can be easily measured by standard techniques the thermal fatigue resistance of different metals can be compared if their resistance to alternating strain, ϵ, is determined. The value of ϵ will depend on the number of thermal cycles, on their frequency and on the temperature conditions. Experience has shown that the thermal stresses that lead to failure by thermal fatigue are generally those occurring when plant is started and stopped. The total number of cycles involved is therefore relatively small, often less than 10,000. For such short endurances most metals are able to withstand some repeated plastic deformation and it is therefore necessary to distinguish between resistance to alternating stress (fatigue strength) and resistance to alternating strain.

Reversed Bending Fatigue

One method for determining the resistance to alternating strain under fluctuating temperature conditions, which has been adopted by a number of investigators, was developed by Coffin and Wesley[3]. A thin tubular specimen is rigidly clamped at its ends and alternately heated by a high alternating current and air cooled. The fluctuating temperature produces a fluctuating axial strain in the specimen and the test is continued until the specimen fractures.

There are two disadvantages of this method, however; firstly the strain range cannot be varied independently of the temperature range and secondly there is a tendency for the specimen to buckle. It was therefore decided to build a reversed bending fatigue machine in which the specimen could be subjected mechanically to alternating strain either at constant temperature or with the temperature fluctuating. A line diagram of the machine is shown in Figure 1 and photographs in Figures 2 and 3.

The specimen S (Fig. 1) is rectangular in section. It is rigidly clamped at its ends to cross shafts X_1 and X_2 which are supported in ball races by a steel framework from the baseplate of the machine. The cross-shafts are tubular in section on either side of a square section centre portion to which the specimen is clamped, and are made of stainless steel to provice adequate heat resistance and low thermal conductivity. Cranked arms A_1 and A_2 are bolted to both ends of the cross-shafts with "sindanyo" heat insulating spacers between them to prevent overheating of the ball-races at the ends of the shafts.

The ball-races supporting the cross-shaft X_2 run in guideways and allow one end of the specimen freedom to move longitudinally when the specimen is bent; this eliminates tensile loading of the specimen. Equal and opposite moments are applied to the ends of the specimen by angular movement of the cross-shafts, the movement being produced by the cranked arms which are oscillated by coupling links L_1 and L_2 connecting the cranked arms to contra-rotating driving cranks C_1 and C_2. To avoid backlash in the drive, angular contact ball-races are fitted at each end of the coupling links.

The strain in the specimen is controlled manually by equal adjustment of the radius of the driving cranks. The maximum crank radius of 3½ in produces a maximum fibre strain of 2½ per cent in a specimen 0·2 in thick. The cranks are mounted on the output shafts of two opposite-handed 20:1 reduction gearboxes G_2 and G_3, which are clamped to the baseplate of the machine, these being coupled to a common 10½:1 reduction gearbox G_1 that is driven by a 70:1

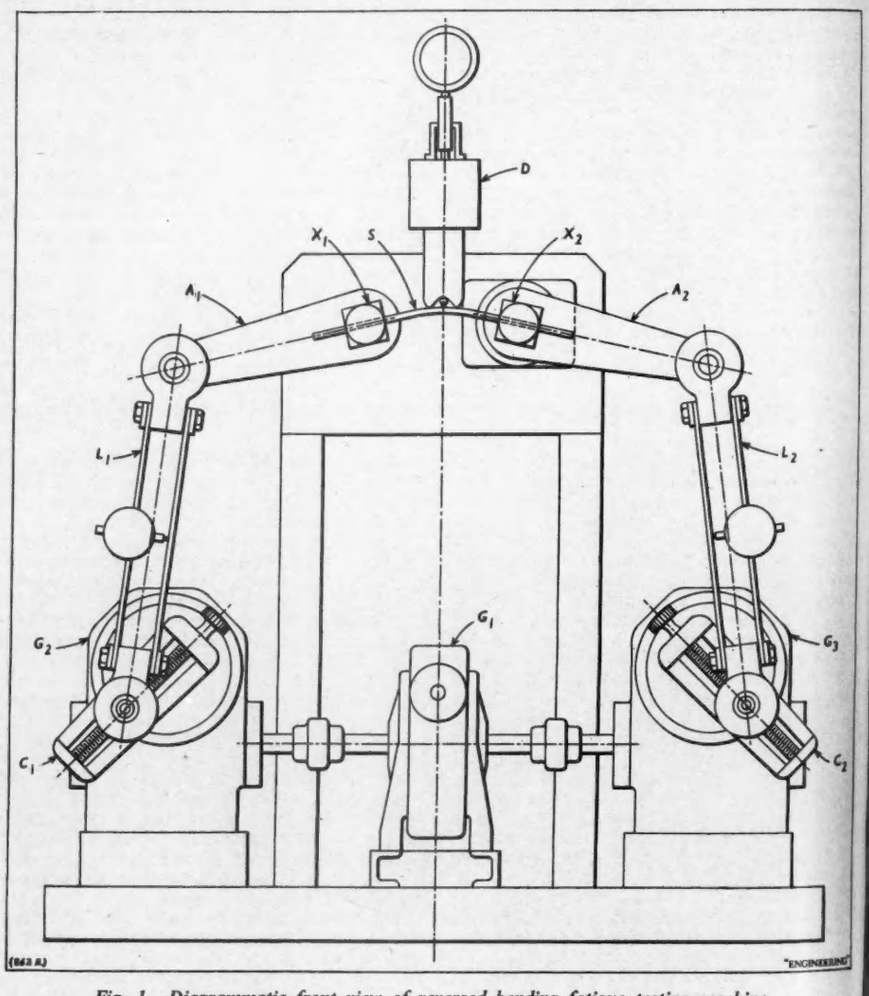


Fig. 1 Diagrammatic front view of reversed bending fatigue testing machine.

Research Report

on work of the

National Physical Laboratory, Teddington, Middlesex.

Research Team

P. G. FORREST, B.Sc.(Eng.), Ph.D., A.M.I.Mech.E. (Metallurgy Division)

A. B. PENFOLD, A.M.I.Mech.E., A.M.I.E.D. (formerly Central Design Office, now Light Division)

geared motor unit. With this arrangement the machine subjects the specimen to a rate of strain reversal of about 1 cycle in 10 minutes. By removing the 10½:1 gearbox and coupling the geared motor unit directly across the opposite-handed 20:1 gearboxes, the rate of strain reversal can be increased to about 1 cycle per minute.

A maximum speed of about 10 cycles per minute is achieved by using a geared motor unit with a 7½:1 ratio in place of the 70:1 geared unit. A striker attached to one of the cranks operates a counter and this records the number of strain cycles required to break the specimen. At fracture, the moving cross-shaft X_4 is pulled by springs against micro-switches that cut off the power supply to the driving motor.

Strain Measurement

The strain in the specimen is calculated from the radius of curvature, which is measured with a simple dial gauge spherometer standing freely on the specimen under test, as shown in Fig. 3. For use up to 600° C a spherometer made of stainless steel has proved satisfactory and for higher temperatures it has been redesigned to incorporate a ceramic body.

While measurement of the strain is the main requirement, provision has also been made for measuring the bending moment. If the relation between the bending moment and the strain is found it is possible to compute the maximum stress even when the specimen deforms non-elastically.

The bending moment is measured by means of the coupling links L_1 L_4 which form a simple elastic load measuring device. Each link is constructed of two thin steel strips (Figs. 1 and 2) clamped at their ends to bearing housings and shaped so that the strips are bowed outwards from each other by 0·1 in at their centres. This ensures that the strips deflect inwards when the coupling link is in tension and outwards when the link is in compression. The relative displacement of each pair of strips is measured with a 0·0001 in Parvus dial gauge having a very light contact pressure.

This method of load measurement was adopted because the strips have a transverse flexibility high enough to provide sufficient sensitivity, but are much stiffer in the longitudinal direction to ensure that nearly all of the crank movement is transmitted to the specimen. The strips are calibrated, when assembled in the machine, by means of a specially-shaped lever and dead weights. For calibration in tension the lever is pivoted on one of the cross-shafts and arranged to exert an upward force on the shaft supporting the link. For calibration in compression it is turned round and pivoted on the latter.

Heating the Specimen

For carrying out tests at constant elevated temperatures a horizontally split electric furnace was constructed. The top half of the furnace was provided with three holes so that the spherometer could be used with the furnace in position (see Fig. 2).

The furnace was not suitable for fluctuating temperature tests because of its high thermal inertia and an alternative method of heating, by passing a high alternating current at a low voltage through the specimen, has therefore been adopted for these tests. A disadvantage of this method of heating is that it is not possible to obtain such a uniform distribution of temperature along the specimen length as with a furnace and it was found necessary to replace the initial spherometer, having a 3 in gauge length, with one that measured the strain in the middle 1 in of the specimen only (Fig. 3).

The variation in temperature along this one inch gauge length is less than 10° C (±5° C) for temperatures up to 800° C. The concentration of heat in the middle of the specimen has the advantage, however, that a simple rectangular-section specimen without enlarged ends can be used without fear of fractures occurring in the grips. A further advantage is that the cross-shafts and the bearings at the ends of the cross-shafts remain comparatively cool. On this account this method of heating is also preferred for constant temperature tests above 700° C.

Great care is required to measure the temperature of the specimen accurately when resistance heating is used, but is it considered that an accuracy within ±5° C at 1,000° C can be achieved with thermocouples of 0·2 mm platinum/platinum-rhodium wires spot-welded to the surface of the specimen. The temperature is controlled by a thermocouple temperature controller which maintains the temperature within ±5° C when steady conditions are reached. To fluctuate the temperature in phase with the applied strain cycle the current flowing through the specimen is interrupted by a mercury switch relay operated by a microswitch, which is controlled by a cam mounted on one of the driving cranks.

Typical Material Behaviour

The results of the tests carried out in this machine will be described in detail elsewhere, but two interesting factors that appear to be of general application may be mentioned. Firstly, it has been found that the resistance to alternating strain when the temperature is fluctuated in phase with the applied strain cycle is about the same as when the temperature is held constant at the maximum value all the time. It may therefore be possible to assess thermal fatigue resistance by constant temperature tests carried out at the appropriate frequency. Secondly, it is apparent that this result is obtained because the resistance of metals to small numbers of alternating strain cycles is markedly reduced at high temperatures.

The range of strain that a metal can withstand for short endurances is partly elastic and partly plastic and the behaviour can best be understood by considering the two separately, thus:—

$$\epsilon = \epsilon_e + \epsilon_p$$

where ϵ_e and ϵ_p are the ranges of elastic and plastic strains respectively. The results of the high temperature tests made so far indicate that ϵ_p is reduced much more than ϵ_e by an increase in temperature.

The value of ϵ_e is directly proportional to the fatigue strength for a given endurance and this is closely related to the tensile strength for short endurances, while Coffin[4] has shown that, at least at room temperature, ϵ_p is approximately related to the ductility in a static tensile test. For very short endurances, say less than 100 stress cycles, ϵ_p is considerably greater than ϵ_e, while for longer endurances ϵ_e becomes predominant. One may therefore expect, in general, that resistance to thermal fatigue will be dependent primarily on ductility for a small number of thermal stress applications and primarily on strength for a large number. This is borne out, to some extent, by the results of experiments[1, 2].

Acknowledgement

The work described above has been carried as part of the General Research Programme of the National Physical Laboratory and this paper is published by permission of the Director of the Laboratory.

References

[1] Glenny, E. and Taylor, T. A.—"The Thermal Fatigue Behaviour of Metals", *J. Inst. Metals*, vol. 88 no. 11 (July 1960) p 449.

[2] Baron, H. G. and Bloomfield, B. S.—"Resistance to Thermal Stress Fatigue of some steels, heat-resisting alloys and cast irons", *J. Iron & Steel Inst.*, vol. 197 part 2 (June 1961) p 223.

[3] Coffin, L. F. and Wesley, R. P.—"Apparatus for the study of the effects of cyclic thermal stresses on ductile metals", *Trans. Amer. Soc. Mech. Engrs.*, vol. 75 (1953) p 923.

[4] Coffin, L. F.—"Cyclic Straining—Fatigue" Symposium on "Internal Stress and Fatigue in Metals", General Motors, USA, (1958). Elsevier, Amsterdam and London (1959), p 363.

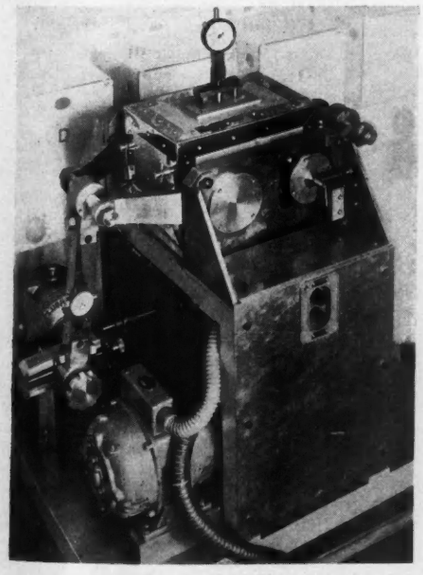


Fig. 2 Reversed bending machine with electric furnace for heating the test specimen.

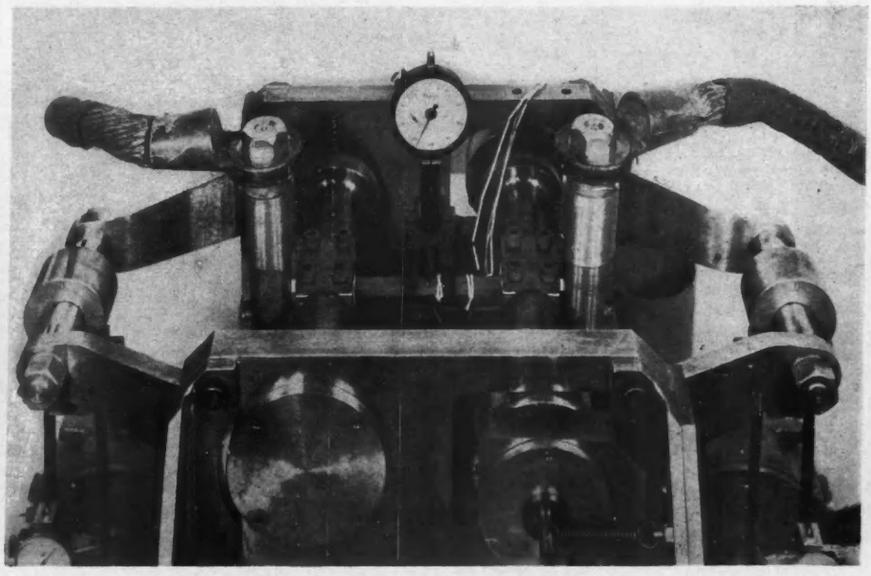


Fig. 3 Machine rigged so as to heat the specimen by direct passage of electric current.

Wash and Freeze

During the last two months English Electric have put on the market two new domestic appliances—a washing machine and a refrigerator.

The washing machine, which was the first to be announced, is the Liberator Tumble-Wash. It is not fully automatic in that each operation has to be started in turn, but timing and switching off occur according to chosen settings. This results in a cheaper machine but one that retains the single tub principle.

The Tumble-Wash needs no permanent plumbing and has a single hose for connecting to the hot or cold water. The water temperature can be selected to suit the fabric (the range is from 90° to 180° F) and the wash time can also be set. The controls are all mounted at the top and the switches are enclosed under a lid. The machine is mounted on castors for easy moving and measures 25 in square by 34 in high. The 19 in diameter tub will take a full 6 to 7 lb of clothes.

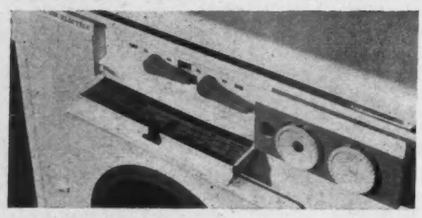
A feature of the machine is the small amount of water used for each wash; there is only a puddle in the bottom of the tub. Consequently there is no need for any method of saving the water from one load to the next. The amount of soap used and lost with each wash is also small, so that the machine is economical to run. As there is only a small amount of water the electricity consumed for heating is not great; the element is rated at 2·75 kW.

A clockwork timer controls the motor which powers the tumbling action, pump and spin. The dial is graduated up to 20 min. When the water has reached the correct temperature the timer can be set to the required washing time. This will start the tumble-wash action which will stop at the chosen time. When the timer dial is set at rinse, the washing can be given either a continuous rinse—carried out by turning on the cold tap and the pump simultaneously so the clothes are tumbled in a continuous flow of clear water—or a series of deep rinses. A lever on the panel controls the pump and a second lever the spin cycle. The timer can be set to any required spin period up to 20 minutes.

One of the advantages of the single tub machine is that there is no handling of the heavy wet clothes. They are put in dry and by the time that spinning is finished, they are again dry enough to be handled easily. The other claim advanced for the tumbler type is that though the water is lost after each load, the amount is small and several loads can be washed (using clean water each time) for the same amount of water used in one loading of the impeller and agitator machines. As in general the weight of clothes per load is the same in all three types, it means that the same water must be used many times in the impeller and agitator machines for the equivalent throughput of clothes.

The other appliance is a Slimline " Fresh and Freeze " combined home freezer and refrigerator. The unit consists virtually of a standard 4 cu. ft refrigerator with a freeze compartment mounted above and reached by a separate door. Overall dimensions are 49½ in high by 21 in wide and 21⅞ in deep excluding the handle. Up to 50 lb of food can be stored in the freeze compartment.

The machine is designed to operate in ambient temperatures up to 110° F under which conditions it will maintain the freeze compartment at below zero F and the main cabinet at just above 40° F. To comply with the high humidity test required by BS 922, a low wattage heater cable runs round the edge of the freeze compartment and behind the mullion bar separating the two cabinets. This heater is continuously energized. Off-cycle defrosting operates automatically in the refrigerator section in which there is an additional low wattage heater that is energized under cold ambient conditions so that the off period is not too long. A drip tray collects the condensate and this can be emptied without disturbing the food in the compartment. The freeze compartment requires defrosting only after long periods as the door is normally opened so much less fequently. Any frost formed can usually be scraped away with a non-metallic spatula. A single dial controls the temperature settings in both compartments.



(Left) The Tumble-Wash has controls for timing, water temperature, and pump and spin operations.

(Left, below) A full load is 6 to 7 lb in the semi-automatic Tumble-Wash.

(Below) The " Fresh and Freeze " will take 50 lb of frozen food and has just over 4 cu. ft for ordinary storage.

ENGINEERING

Published every Friday by Engineering Ltd., at 36 Bedford Street, London WC2, England.
Telephone: Temple Bar 3663.
Telegrams: Engineering Lesquare London.

Chairman
J. A. Dixon, M.A., A.M.I.Mech.E.

Editor
F. B. Roberts, M.B.E., M.I.Mech.E.

Deputy Editors
D. Fisher, Ph.D., B.Sc., A.M.I.C.E., A.M.I.Mech.E.
A. A. H. Scott, B.Sc., A.M.I.Mech.E.

Department Editors
Book Reviews and At Home
A. A. H. Scott (Deputy Editor)
Construction
D. Fisher (Deputy Editor)
Design
J. T. Godfrey
Companies and Events in Advance
J. E. Dodsworth
Marketing
J. L. Tosen
Metals and Materials
D. C. E. Gribble, B.Sc.
New Plant and Equipment
C. R. H. Simpson
Product Profile
K. M. Brown
Production and Human Element
G. T. Page, M.A.
Research
R. A. Coffee, D.I.C., A.M.Brit.I.R.E.
Special Articles
P. B. Jones

SUBSCRIPTION MANAGER
G. A. Roberts

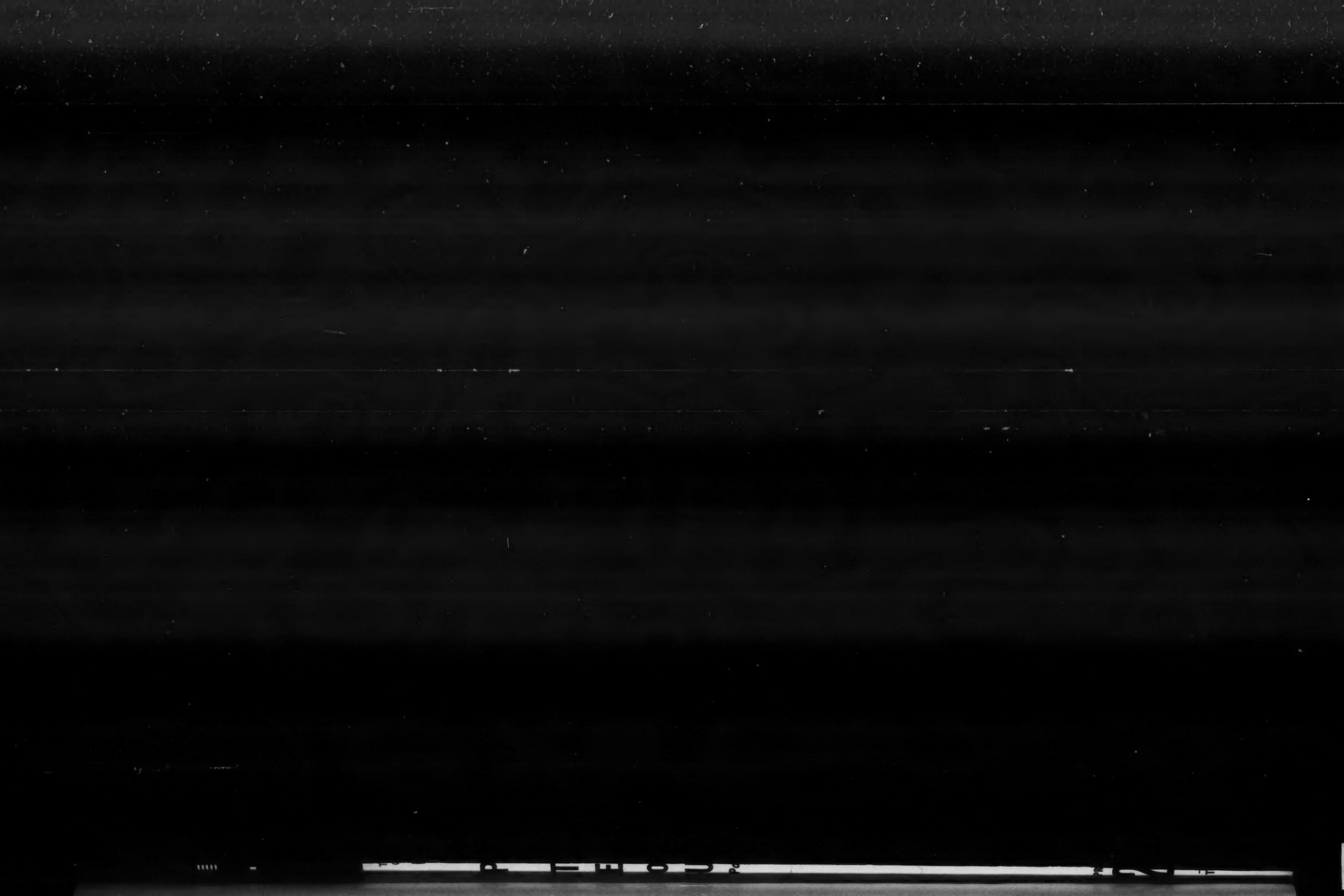
ADVERTISEMENT MANAGER
G. H. Dixon, M.A.

Contributed Articles
Notes for the guidance of contributors are available from the Editor. Contributed articles usually carry the author's name when published; they should be exclusive to ENGINEERING. When an article is accepted for publication the author is normally advised of the planned publication date.

Subscription Rates
One year, inland and abroad £5 10*s* (Canada, £5 5*s*). Three months 27*s* 6*d* all countries. Single copies 2*s* 7*d* post paid.

Back Numbers
Back numbers, from recent issues to certain of the earliest issues from 1866, are available at the usual price for single copies.

Reprints
Reprints of articles which have been published in ENGINEERING can be supplied. Requests for quotations, stating the quantity required, should be addressed to the Reprints Department.

Engineering Information Service
Assistance is available from Engineering Information Service in obtaining information, and in locating sources of information, both technical and commercial. EIS deals, for example, with names of makers and suppliers of plant and equipment, technical data on design, markets for engineering products, and the compilation of references to information on specific topics. Inquiries should be addressed to Engineering Information Service, 36 Bedford Street, London WC2.

Advertisement Rates
The rates for advertising in the classified advertisement sections (Appointments, Company Meetings, Trade and Technical) are given in those sections. The Rate Card, covering all advertisements including display, is available from the Advertisement Manager.